

Japan's Comment to TRANS/WP.29/GRSP/2005/3

Transmitted by the expert from Japan

A Proposal:

Japan proposes to insert the following texts of the legform test method into Pedestrian Safety Global Technical Regulation Preamble.

B Justification:

It was agreed by the Informal Group on Pedestrian Safety that the following texts were included into the Preamble.

5. Performance Requirements.

5.1 Legform to Bumper:

- 5.1.1 When tested in accordance with section 7.1.1 (lower legform to bumper), the maximum dynamic knee elongations shall not exceed [20 mm] for MCL (comparable to 20 deg.), [10 mm] for ACL, and [10 mm] for PCL, the maximum dynamic strains on the bone core of the leg shall not exceed [350 Nm].

6. Test Conditions

6.1 General Site Conditions

6.1.1 Temperature and humidity

The stabilised temperature of the test tools and of the vehicle or sub-system at the time of testing shall be [20° ± 4°] C. The relative humidity of the test area where all equipment is held should be [10 to 70] % after a stabilised period of at least four hours prior to the application of any test.

- 6.1.1.1 Sufficient time must be allowed before testing for the temperature of all vehicle components to stabilise to the required temperature range.

- 6.1.1.2 Relative humidity and temperature shall be measured at the time of the test, and recorded in the test report.

6.1.2 Impact test site

The test site shall consist of a flat, smooth and hard surface with a slope not exceeding 1 %.

6.2 Preparation of the vehicle

- 6.2.1 Either a complete vehicle or a cut-body adjusted to the following conditions, shall be used for the test.

- 6.2.1.1 The vehicle shall be in its normal ride attitude and shall be either securely mounted on raised supports or at rest on a flat surface. The parking brake shall be applied, or the cut-body shall be securely mounted.

- 6.2.1.2 The cut-body shall include all parts of the vehicle front structure and under bonnet components, or behind windscreen components, that may be involved in a frontal impact with a vulnerable road user in the test, to demonstrate the performance and interactions of all the contributory vehicle components.

- 6.2.1.2.1 The cut-body shall be securely mounted in the normal vehicle ride attitude.

- 6.2.2 All devices designed to protect vulnerable road users shall be correctly activated before and/or be active during the appropriate test. It shall be the responsibility of the manufacturer to show that any devices will act as intended in a pedestrian impact.

- 6.2.3 Any vehicle component which could change shape or position, such as 'pop-up' headlights, other than active devices to protect pedestrians, shall be set to a shape or

position that the test institutes in consultation with the manufacturer consider to be the most appropriate for these tests.

6.3 Test impactor specifications

6.3.1 Legform impactors:

6.3.1.1 Lower legform impactor:

The lower legform impactor shall consist of two foam covered flexible segments, representing femur (upper leg) and tibia (lower leg), joined by a flexible knee joint. The overall length of the impactor shall be $926 \pm [5]$ mm, having a required test mass of $13,4 \pm [0,2]$ kg. Brackets, pulleys, etc. attached to the impactor for the purpose of launching it, may extend the dimensions.

6.3.1.1.1 The diameter of the femur and tibia shall be 70 ± 1 mm and both shall be covered by flesh. The flesh shall be made of two 5 mm thickness neoprene sheets, 5 mm thickness rubber sheet, and one 5 mm thickness neoprene sheet.

6.3.1.1.2 The 'centre of the knee' is defined as the tibial condyle flat surface.

6.3.1.1.3 The 'thigh' is defined as all components or parts of components (including flesh, skin covering, instrumentation and brackets, pulleys, etc. attached to the impactor for the purpose of launching it) above the level of the centre of the knee.

6.3.1.1.4 The 'leg' is defined as all components or parts of components (including flesh, skin covering, instrumentation, etc. attached to the impactor for the purpose of launching it) below the level of the centre of the knee. Note that the tibia as defined includes allowances for the mass, etc., of the foot.

6.3.1.1.5 The total mass of the femur and tibia shall be $8,6 \pm [0,1]$ kg and $4,8 \pm [0,1]$ kg respectively, and the total mass of the impactor shall be $13,4 \pm [0,2]$ kg. The centre of gravity of the femur and tibia shall be $217 \pm [10]$ mm and $233 \pm [10]$ mm from the centre of the knee respectively. The moment of inertia of the femur and tibia, about a horizontal axis through the respective centre of gravity and perpendicular to the direction of impact, shall be $0,127 \pm [0,010]$ kg/m² and $0,120 \pm [0,010]$ kg/m² respectively.

6.3.1.1.6 Lower legform instrumentation

6.3.1.1.7.1 Four strain gages (Leg 1, Leg 2, Leg 3 and Leg 4) shall be fitted on the bone core of leg, Leg 1: 134 mm, Leg 2: 214 mm, Leg 3: 294 mm, Leg 4: 374mm below the knee joint centre.

6.3.1.1.7.2 The impactor shall be instrumented to measure the knee ligaments (MCL, ACL, and MCL) elongations.

6.3.1.1.7.4 Transducers shall be fitted to measure knee ligaments elongation. Four strain gages shall be fitted on the bone core of leg.

6.3.1.1.7.5 The instrumentation response value CFC, as defined in ISO 6487:2000, shall be 180 for all transducers. The CAC response values, as defined in ISO 6487:2000, shall be 25 mm for the knee ligament elongations, 16,000 microstrain for the strain gages. This does not require that the impactor itself be able to physically elongate or generate

strain.

6.3.1.1.8 Lower legform certification

6.3.1.1.8.1 The lower legform impactor shall meet the performance requirements specified in section 8.

6.3.1.1.8.2 The certified impactor may be used for a maximum of [20] impacts before re-certification. The impactor shall also be re-certified if more than one year has elapsed since the previous certification or if any impactor transducer output, in any impact, has exceeded the specified CAC.

6.3.1.1.9 The lower legform impactor for the bumper tests shall be in 'free flight' at the moment of impact. The impactor shall be released to free flight at such a distance from the vehicle that the test results are not influenced by contact of the impactor with the propulsion system during rebound of the impactor.
The impactor may be propelled by an air, spring or hydraulic gun, or by other means that can be shown to give the same result.

7. Test Procedures.

7.1 Legform to Bumper Test Procedures

7.1.1 Lower leg form to bumper test procedure:

7.1.1.1 A minimum of three lower legform to bumper tests shall be carried out, one each to the middle and the outer thirds of the bumper at positions judged to be the most likely to cause injury. Tests shall be to different types of structure, where they vary throughout the area to be assessed. The selected test points shall be a minimum of 132 mm apart, and a minimum of 66 mm inside the defined corners of the bumper. These minimum distances are to be set with a flexible tape held tautly along the outer surface of the vehicle. The positions tested by the laboratories shall be indicated in the test report.

7.1.1.1.1 Manufacturers might apply for derogation concerning an exemption zone for a removable towing hook.

7.1.1.2 The direction of the impact velocity vector shall be in the horizontal plane and parallel to the longitudinal vertical plane of the vehicle. The tolerance for the direction of the velocity vector in the horizontal plane and in the longitudinal plane shall be $\pm [2]^\circ$ at the time of first contact. The axis of the impactor shall be perpendicular to the horizontal plane with a tolerance of $\pm [2]^\circ$ in the lateral and longitudinal plane. The horizontal, longitudinal and lateral planes are orthogonal to each other (see Figure 18).

7.1.1.3 The bottom of the impactor shall be at 25 mm above from the ground reference level at the time of first contact with the bumper (see Figure 19), with a $\pm [10]$ mm tolerance. When setting the height of the propulsion system, an allowance must be made for the influence of gravity during the period of free flight of the impactor.

7.1.1.3.1 At the time of first contact the impactor shall have the intended orientation about its vertical axis, for the correct operation of its knee joint, with a tolerance of $\pm [5]^\circ$ (see Figure 18).

8. Certification of Impactors.

8.1. Dynamic certification test

- 8.1.1. The flexible legform impactor shall meet the requirements specified in point 8.1.2 when tested as specified in point 8.1.4.

The stabilised temperature of the impactor during certification shall be $20\text{ }^{\circ}\text{C} \pm [2]\text{ }^{\circ}\text{C}$.

- 8.1.2. When the impactor is conducted the certification test as specified in point 8.1.4, the maximum leg moment measured by strain gages shall be not less than, Leg 1: [100] Nm, Leg 2: [70] Nm, Leg 3: [50] Nm, Leg 4: [20] Nm, and not more than, Leg 1: [140] Nm, Leg 2: [100] Nm, Leg 3: [75] Nm, Leg4 [35] Nm. The maximum elongation of knee ligaments shall be not less than, ACL: [4] mm, PCL: [3.5] mm, MCL: [12] mm, and not more than ACL: [6] mm, PCL: [5.5] mm, MCL: [14] mm.

For all these values the readings used shall be from the initial impact phase, 0 ms to 50 ms.

- 8.1.3. The instrumentation response value CFC, as defined in ISO 6487:2000, shall be 180 for all transducers. The CAC response values, as defined in ISO 6487:2000, shall be 25 mm for the knee ligament elongations, 16,000 microstrain for the strain gages. This does not require that the impactor itself be able to physically elongate or generate strain.

8.1.4 Test procedure

- 8.1.4.1. The impactor, including flesh, shall be suspended 15 degree above from horizontally, as shown in Figure 8a. It shall be suspended with its longitudinal axis vertical, with a tolerance of $\pm [2\text{ }^{\circ}]$. The impactor must meet the requirements of point 8.1.2.

- 8.1.4.2. The impactor stopper shall have a rigid construction regarding the impact energy. The dimensions of the impacted face of the stopper and impact location shall be as specified in Figure 8b.

The impactor suspend pin joint shall be low friction. The guides shall prevent motion in other directions including rotation about any axis.

- 8.1.4.3. The impactor shall be tested by free fall condition.

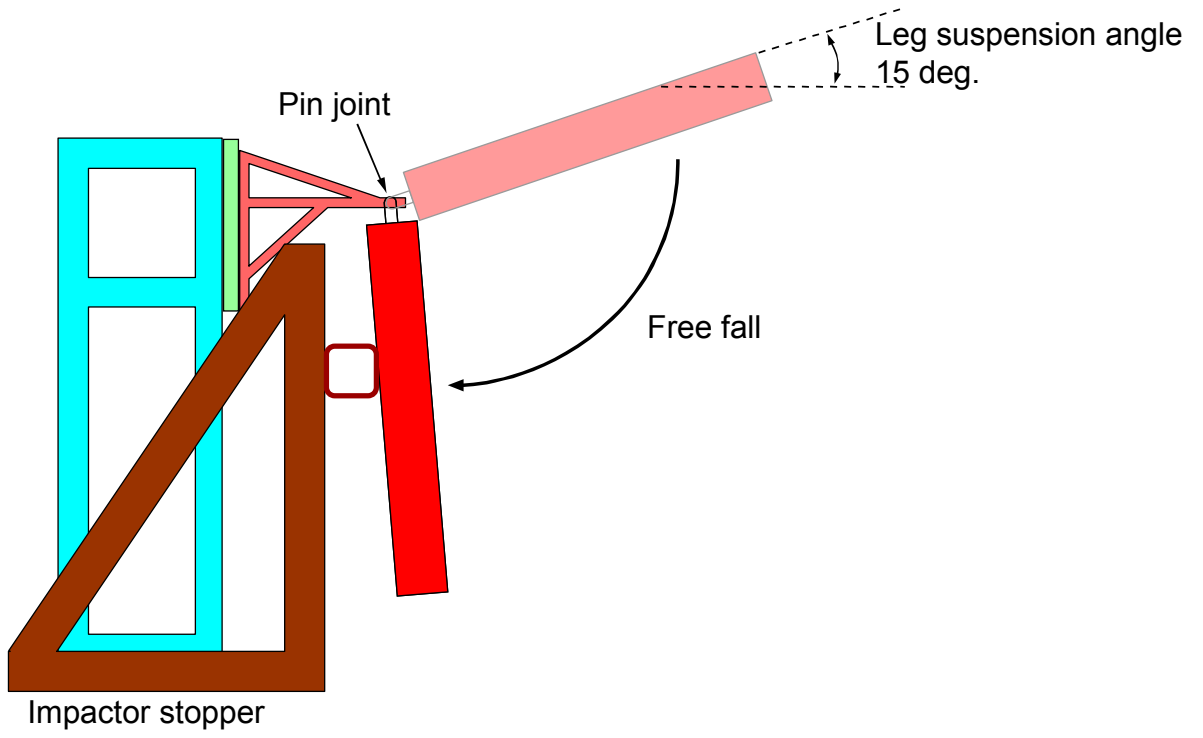


Figure 8a: Certification test for the Flexible Legform Impactor

Impact location

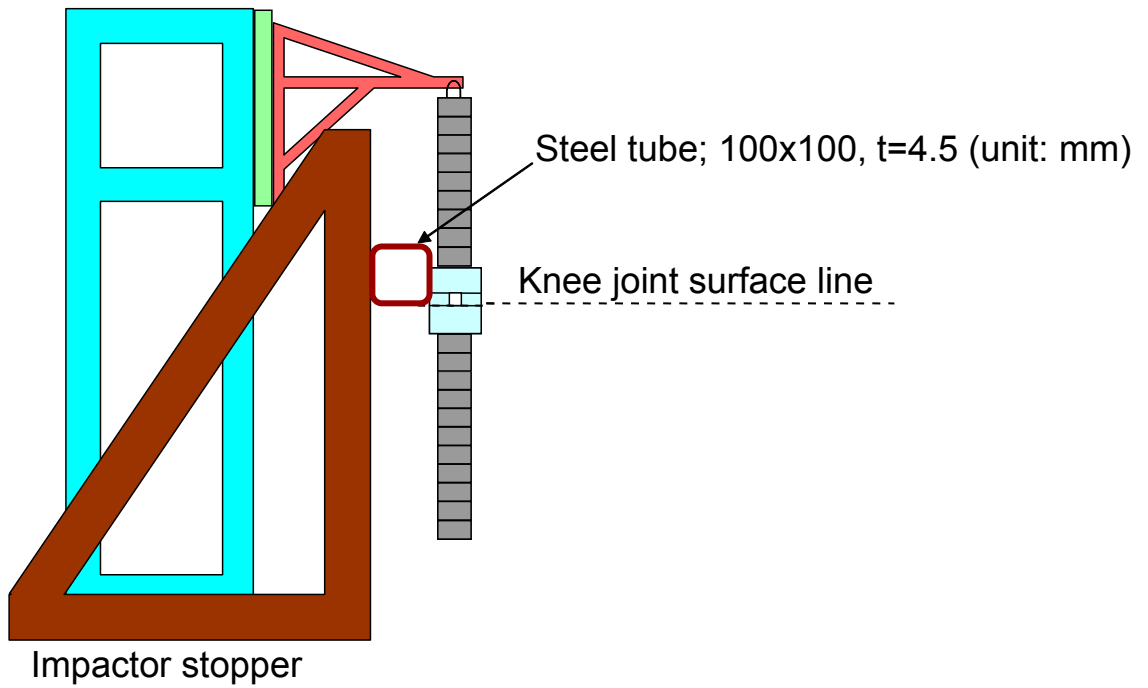


Figure 8b: Impact location