

Proposal for the 01 series amendments to new ECE Regulation on pedestrian safety

Submitted by the expert from Japan*

The text reproduced below was prepared by the expert from Japan in order to propose the use of the Flexible Pedestrian Legform Impactor (FlexPLI) in the upcoming new ECE on pedestrian safety (the new ECE on pedestrian safety (ECE/TRANS/WP29/2010/127) is waiting an adaption by the WP29). It is based on ECE/TRANS/WP.29/GRSP/2010/2, GRSP-47-32 and GRSP-47-34 distributed during the forty-seventh session of the Working Party on Passive Safety (GRSP). The modifications to the current text of the new ECE on pedestrian safety are marked in bold or strikethrough characters.

I. Proposal

Paragraph 5.1.1., amend to read:

“5.1.1. Lower legform to bumper

When tested in accordance with Annex 5, paragraph 1.2 (Flex-PLI to bumper test procedure), the maximum dynamic medial collateral ligament elongation at the knee shall not exceed 22 mm, and the dynamic bending moments at the tibia shall not exceed 340 Nm. The maximum dynamic anterior cruciate ligament and posterior cruciate ligament elongation shall not exceed 13 mm.

In addition, the manufacturer may nominate bumper test widths up to a maximum of 264 mm in total where the tibia bending moment of the FlexPLI shall not exceed 380 Nm. A contracting party may restrict application of the relaxation zone requirement in its domestic legislation if it decides that such restriction is appropriate.

The Flexible Pedestrian lower legform impactor shall be certified pursuant to Annex 6, paragraph 1.2

~~When tested in accordance with Annex 5, paragraph 1. (lower legform to bumper), the maximum dynamic knee bending angle shall not exceed 19°, the maximum dynamic knee shearing displacement shall not exceed 6.0 mm, and the acceleration measured at the upper end of the tibia shall not exceed 170 g. In addition, the manufacturer may nominate bumper test widths up to~~

* In accordance with the programme of work of the Inland Transport Committee for 2006–2010 (ECE/TRANS/166/Add.1, programme activity 02.4), the World Forum will develop, harmonize and update Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

a maximum of 264 mm in total where the acceleration measured at the upper end of the tibia shall not exceed 250 g.

The lower legform impactor shall be certified pursuant to Annex 6, paragraph 1.”

Insert New Paragraph 11. , to read:

11 TRANSITIONAL PROVISIONS

11.1 As from the official date of entry into force of the 01 series of amendments to this Regulation, no Contracting Party applying this Regulation shall refuse to grant approval under this Regulation as amended by the 01 series of amendments.

11.2 As from [84] months after the date of entry into force, Contracting Parties applying this Regulation shall grant approvals only if the vehicle type to be approved meets the requirements of this Regulation as amended by the 01 series of amendments.

11.3 Contracting Parties applying this Regulation shall not refuse to grant extensions of approval to the original version of this Regulation.

11.4 Contracting Parties applying this Regulation shall continue to grant approvals to those types of vehicles which comply with the requirements of this Regulation in its original version during the [84] months' period which follows the date of entry into force of the 01 series of amendments.

11.5 No Contracting Party applying this Regulation shall refuse national or regional type approval of a vehicle type approved to the 01 series of amendments to this Regulation.

[11.6 Even after the entry into force of the 01 series of amendments to this Regulation, approvals of the vehicles to the original version of this Regulation shall remain valid and Contracting Parties applying this Regulation shall continue to accept them.]

Insert New Paragraph 7.of Annex 1 (part 2), amend to read:

“7. Utilized Lower legform impactor: FlexPLI only/ Flex-PLI and EEVC WG17^{2/} “

Paragraph 7.(former) to 15.(former) of Annex 1 (part 2), renumber as Paragraph 8. to 16.

Paragraph 1.of Annex 4, amend to read:

Deleted: Until [84] months after the date of entry into force of the 01 series of amendments to this Regulation, in case of a car can not full fill the Maximum ACL and PCL elongation \leq 13 mm with Flex-PLI, the car shall fulfil the Maximum lateral knee shearing displacement \leq 6mm with EEVC WG17 lower legform impactor in stead if the car need to obtain an approval from a contracting party. In this case the EEVC WG17 lower legform impactor testing, the impactor shall be certified pursuant to Annex 6, paragraph 1.1. and then the test shall be conducted accordance with Annex 5, paragraph 1.1 (EEVC WG17 legform impactor to bumper test procedure).

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“1. Lower legform impactors”

Insert New Paragraph 1.1. of Annex 4, to read:

“1.1. **EEVC WG17 pedestrian lower legform impactor**”

Paragraph 1.1. to 1.4. (former) of Annex 4, renumber as Paragraph 1.1.1 to 1.1.4.

Paragraph 2. (former) of Annex 4, renumber as Paragraph 1.2. and amend to read:

“... **EEVC WG17 pedestrian** ~~lower legform instrumentation~~”

Paragraph 2.1. to 2.4. (former) of Annex 4, renumber as Paragraph 1.2.1 to 1.2.4.

Title of Figure 1. of Annex 4, amend to read:

“Figure 1: **EEVC WG17 pedestrian** ~~lower legform impactor~~”

Insert new paragraphs 1.3. to 1.4.4., to read:

“1.3. **Flexible pedestrian lower legform impactor (FlexPLI):**

1.3.1. **The lower legform impactor shall consist of flesh, flexible long bone segments (representing femur and tibia), and a knee joint as shown in Figure 2.**

The overall length of the impactor shall be 928 ± 3 mm, having a required mass of 13.2 ± 0.7 kg including flesh. The length of the femur, knee joint, and tibia shall be 339 ± 2 mm, 185 ± 1 mm, and 404 ± 2 mm respectively. The knee joint centre position shall be 94 ± 1 mm from the top of the knee joint.

Brackets, pulleys, protectors, connection parts etc. attached to the impactor for the purpose of launching and/or protecting may extend beyond the dimensions shown in Figure 2.

1.3.2. **The cross-sectional shape perpendicular to the Z axis of the femur and tibia main bodies shall be 90 ± 2 mm in width along the Y axis, and 84 ± 1 mm in width along the X axis as shown in Figure 3 (a). The impact face shall be 30 ± 1 mm in radius, 30 ± 1 mm in width along the Y axis, and 48 ± 1 mm in width along the X axis as shown in Figure 3 (a).**

1.3.3. **The cross-sectional shape perpendicular to the Z axis of the knee joint shall be 108 ± 2 mm in width along the Y axis, and 118 ± 1 mm in width along the X axis as shown in Figure 3 (b). The impact face shall be 103 ± 1 mm in radius, 12 ± 1 mm in width along the Y axis, and 86 ± 1 mm in width along the X axis as shown in Figure 3 (b).**

1.3.4. **The masses of the femur and tibia without flesh, including the connection part to the knee joint, shall be 2.46 ± 0.12 kg and 2.64 ± 0.13 kg respectively. The mass of the knee joint without flesh shall be 4.28 ± 0.21**

kg. The total mass of the femur, knee joint, and tibia shall be 9.38 ± 0.47 kg.

The centre of gravity of the femur and tibia without flesh, including the connection part to the knee joint, shall be 159 ± 8 mm and 202 ± 10 mm respectively from the top, but not including the connection part to the knee joint, of each part as shown in Figure 2. The centre of gravity of the knee joint shall be 92 ± 5 mm from the top of the knee joint as shown in Figure 2.

The moment of inertia of the femur and tibia without flesh, including the connection part inserted to the knee joint, about the X axis through the respective centre of gravity shall be 0.0325 ± 0.0016 kgm² and 0.0467 ± 0.0023 kgm² respectively. The moment of inertia of the knee joint about the X axis through the respective centre of gravity shall be 0.0180 ± 0.0009 kgm².

- 1.3.5. For each test, the impactor (femur, knee joint, and tibia) shall be covered by flesh composed of synthetic rubber sheets (R1, R2) and neoprene sheets (N1F, N2F, N1T, N2T, N3) as shown in Figure 4. The sheets are required to have a compression characteristic as shown in Figure 5. The compression characteristic shall be checked using the same batch of sheets as those used for the impactor flesh. The size of the sheets shall be within the requirements described in Figure 5.
- 1.3.6. The test impactor or at least the flesh shall be stored for at least four hours in a controlled storage area with a stabilised temperature of $20 \pm 2^\circ\text{C}$ prior to impactor removal for calibration. After removal from the storage, the impactor shall not be subjected to conditions other than those pertaining in the test area.
- 1.4. Flex-PLI lower legform instrumentation
- 1.4.1. Four transducers shall be installed in the tibia to measure bending moments applied to the tibia. The sensing locations of each of the transducers are as follows: tibia-1: 134 ± 1 mm, tibia-2: 214 ± 1 mm, tibia-3: 294 ± 1 mm, and tibia-4: 374 ± 1 mm below the knee joint centre respectively as shown in Figure 6. The measurement axis of each transducer shall be the X axis of the impactor.
- 1.4.2. Three transducers shall be installed in the knee joint to measure elongations of the medial collateral ligament (MCL), anterior cruciate ligament (ACL), and posterior cruciate ligament (PCL). The measurement locations of each transducer are shown in Figure 6. The measurement locations shall be within ± 3 mm along the X axis from the knee joint centre.
- 1.4.3. The instrumentation response value channel frequency class (CFC), as defined in ISO 6487:2002, shall be 180 for all transducers. The CAC response values, as defined in ISO 6487:2002, shall be 30 mm for the knee ligament elongations and 400 Nm for the tibia bending moments. This does not require that the impactor itself be able to physically elongate or bend until these values.
- 1.4.4. The measurements for the FlexPLI must be taken only for the major impact with the vehicle prior to the rebound phase. All maxima occurring during or after the rebound phase shall be ignored. For example, the zero crossing after the maximum of the MCL elongation or

of the tibia bending moments shall be considered as the end of the major impact with the vehicle. The major impact with the vehicle and therefore the measurement interval should normally not exceed 50 ms after the first contact. Maxima occurring near the end of the 50 ms timeframe should be reviewed individually.”

Insert new Figures 2 to 6., to read:

“

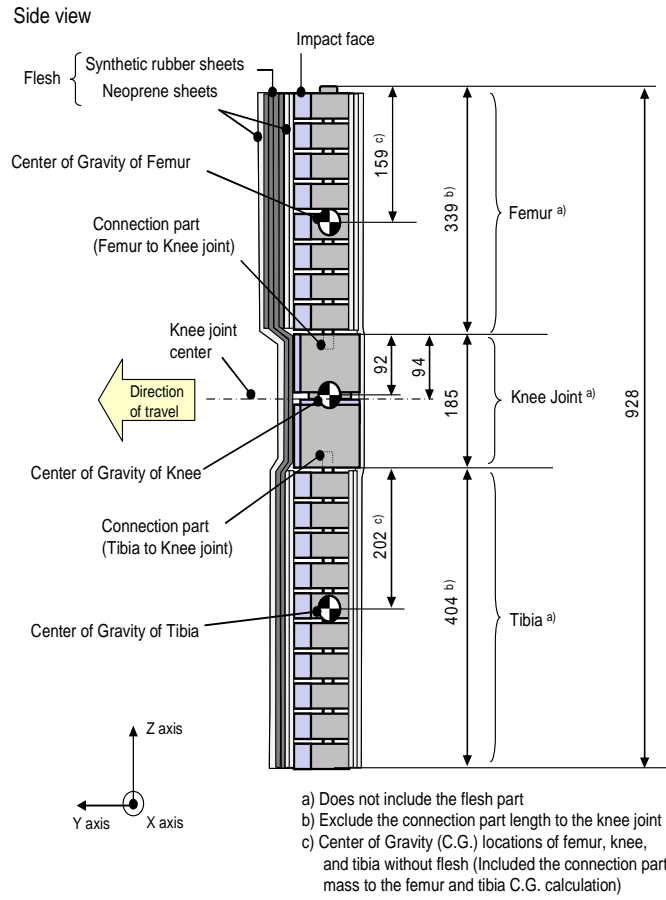


Figure 2: FlexPLI; Dimensions and C.G. locations of femur, knee joint, and tibia (Side view)

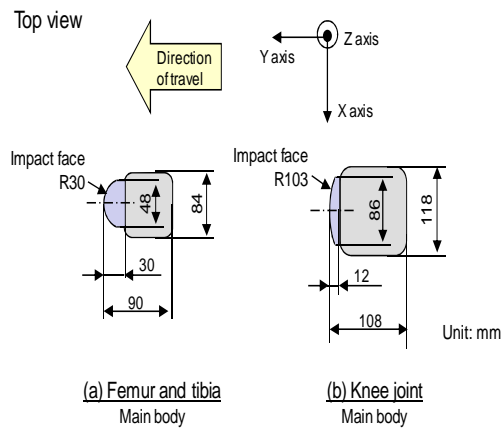


Figure 3: FlexPLI; femur, tibia, and knee dimensions (Top view)

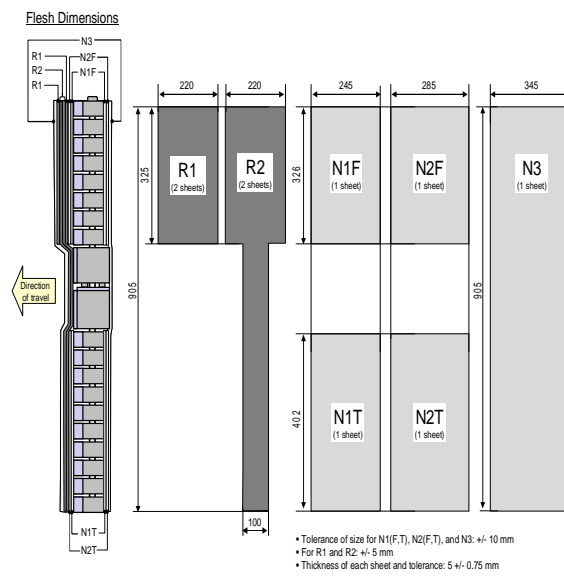
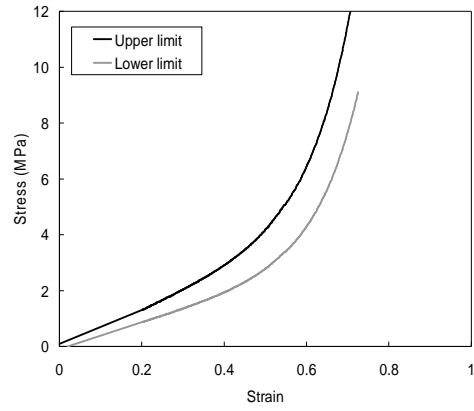
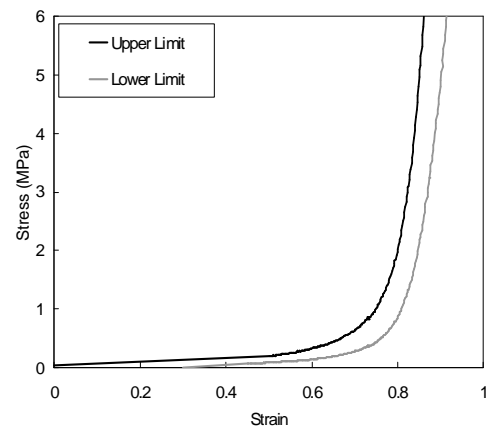


Figure 4: FlexPLI; flesh dimensions



(a) Synthetic rubber sheets



(b) Neoprene sheets

Figure 5: FlexPLI; flesh compression characteristics

“... Child headform impactor (see Figure38).”

Paragraph 5.2.2. (former) of Annex 4, amend to read:

“... perpendicular to the mounting face A (see Figure38) and its seismic mass ...”

Figure 3. (former) of Annex 4, renumber as Figure 8.

Paragraph 5.3. (former) of Annex 4, amend to read:

“... Adult headform impactor (see Figure49).”

Figure 4. (former) of Annex 4, renumber as Figure 9.

Paragraph 5.4.2. (former) of Annex 4, amend to read:

“... perpendicular to the mounting face A (see Figure49) and its seismic mass ...”

Paragraph 1. of Annex 5, amend to read:

“1. Lower legform **impactors** to bumper”

Insert New Paragraph 1.1. of Annex 5, to read:

“**1.1. EEVC WG17 pedestrian lower legform to bumper test procedure**”

Paragraph 1.1. to 1.12. (former) of Annex 5, renumber as Paragraph 1.1.1. to 1.1.12.

Insert new paragraphs 1.2. to 1.2.4. of Annex 5, to read:

“**1.2. FlexPLI to bumper test procedure**

Each test shall be completed within two hours of when the impactor to be used is removed from the controlled storage area.

1.2.1. The selected target points shall be in the bumper test area.

1.2.2. 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 roll and pitch angle tolerance of $\pm 2^\circ$ in the lateral and longitudinal plane. The horizontal, longitudinal and lateral planes are orthogonal to each other (see Figure 3).

1.2.3. The bottom of the impactor shall be at 75 mm above ground reference plane at the time of first contact with the bumper (see Figure 4), with a ± 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.

1.2.3.1. 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.

1.2.3.2. 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 yaw angle tolerance of $\pm 5^\circ$ (see Figure 3).

1.2.3.3. At the time of first contact the centre line of the impactor shall be within a ± 10 mm tolerance to the selected impact location.

1.2.3.4. During contact between the impactor and the vehicle, the impactor shall not contact the ground or any object which is not part of the vehicle.

1.2.4. The impact velocity of the impactor when striking the bumper shall be 11.1 ± 0.2 m/s. The effect of gravity shall be taken into account when the impact velocity is obtained from measurements taken before the time of first contact."

Insert new Figures 3 and 4. of Annex 5, to read:

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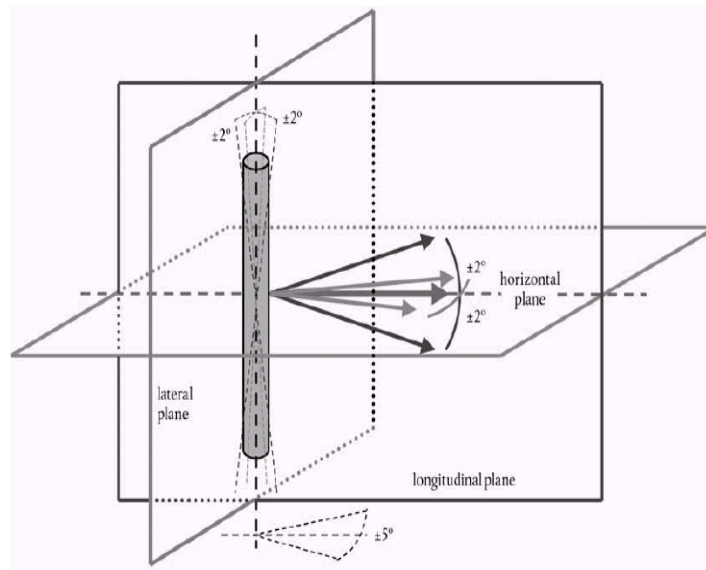


Figure 3: Tolerances of angles for the lower legform impactor at the time of the first impact (see paragraphs 1.2.2. and 1.2.3.2.)

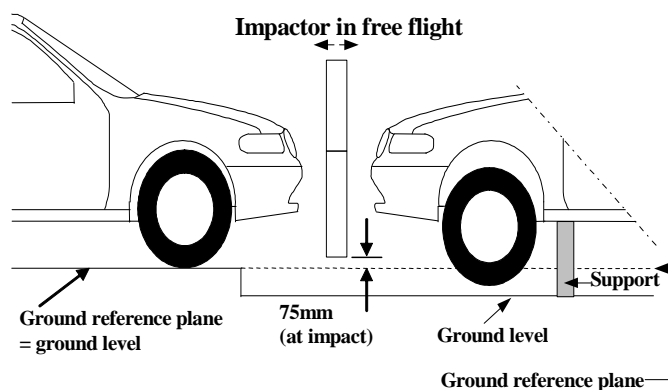


Figure 4: FlexPLI to bumper tests for complete vehicle in normal ride attitude (left) and for cut-body mounted on supports (right) (see paragraph 1.2.3.)”

Paragraph 3.4.1. of Annex 5, amend to read:

“... or 1,700 (HIC1700 zone) (see Figure35).”

Figure 3. of Annex 5, renumber as Figure 5.

Paragraph 1. of Annex 6, amend to read:

“1. Lower legform impactors certification”

Paragraph 1.1. to 1.3.3.5. of Annex 6, renumber as Paragraph 1.1.1. to 1.1.3.3.5.

Insert New Paragraph 1.1. of Annex 6, to read:

“1.1. EEVC WG17 pedestrian lower legform impactor certification”

Insert new paragraphs 1.2. to 1.2.4.4.4. of Annex 6, to read:

“1.2. **FlexPLI certification**

1.2.1. The impactor has to be certified according to the inverse type dynamic certification test described in paragraph 1.2.4. in advance of to start the homologation test series. The certified impactor shall be certified according to the pendulum type dynamic certification test described in paragraph 1.2.3. after every 10 car tests*, as well as inverse type dynamic certification test after every 30 car tests (*no need to perform pendulum type dynamic certification test after every 30 car tests). The impactor shall be re-certified by these dynamic tests if more than one year has elapsed since the previous dynamic certification tests, if any

impactor transducer output has exceeded the specified CAC. If the impactor fails the dynamic certification tests, it shall be re-certified by using the static calibration test described in paragraph 1.2.2. in order to identify the parts that shall be changed to new ones.

1.2.2. Static certification tests

1.2.2.1. The femur and tibia of the lower legform impactor shall meet the requirements respectively specified in paragraph 1.2.2.2. when tested as specified in paragraph 1.2.2.4. The knee joint of the lower legform impactor shall meet the requirements specified in paragraph 1.2.2.3. when tested as specified in paragraph 1.2.2.5. The stabilised temperature of the impactor during the certification tests shall be $20^{\circ} \pm 2^{\circ}\text{C}$.

The CAC response values, as defined in ISO 6487:2002, shall be 30 mm for the knee ligament elongations and 5 kN for the applied external load. For these tests low-pass filtering at an appropriate frequency is permitted, to remove higher frequency noise without significantly affecting the measurement of the response of the impactor.

1.2.2.2. When the femur and tibia of the impactor are loaded in bending in accordance with paragraph 1.2.2.4., the applied moment and generated deflection at the centre of the femur and tibia (M_c and D_c) shall be within the corridors shown in Figure 7.

1.2.2.3. When the knee joint of the impactor is loaded in bending in accordance with paragraph 1.2.2.5., the MCL, ACL, and PCL elongations and applied bending moment or force at the centre of the knee joint (M_c or F_c) shall be within the corridors shown in Figure 8.

1.2.2.4. The edges of the femur and tibia, not bending parts, shall be mounted to the support rig firmly as shown in Figure 9 and Figure 10. The Y axis of the impactor shall be parallel to the loading axis within $180 \pm 2^{\circ}$ tolerance. In order to avoid friction errors, roller plates shall be set underneath the support rigs.

The centre of the loading force shall be applied at the centre of the femur and tibia within $\pm 2^{\circ}$ tolerance along the Z axis. The force shall be increased at a rate between 10 and 100 mm/minute until the bending moment at the centre part (M_c) of the femur or tibia reaches 400 Nm.

1.2.2.5. The edges of the knee joint, not bending parts, shall be mounted to the support rig firmly as shown in Figure 11. The Y axis of the impactor shall be parallel to the loading axis within $180 \pm 2^{\circ}$. In order to avoid friction errors, roller plates shall be set underneath the support rigs. To avoid impactor damage, a neoprene sheet shall be set underneath the loading ram and the impactor face of the knee joint which is described in the Figure 3 of Annex 4 shall be removed. The neoprene sheet used in this test shall have compression characteristics as shown in Figure 5 of Annex 4.

The centre of the loading force shall be applied at the centre of the knee joint within $\pm 2^{\circ}$ tolerance along the Z axis. The external load shall be increased at a rate between 10 and 100 mm/minute until the bending moment at the centre part of the knee joint (M_c) reaches 300 Nm.

1.2.3. Dynamic certification tests (pendulum type)

- 1.2.3.1. The lower legform impactor (femur, knee joint, and tibia are connected/assembled firmly) shall meet the requirements specified in paragraph 1.2.3.3. when tested as specified in paragraph 1.2.3.4.
- 1.2.3.2. Certification
 - 1.2.3.2.1. The test facility used for the certification test shall have a stabilised temperature of 20 ± 2 °C during certification.
 - 1.2.3.2.2. The temperature of the certification area shall be measured at the time of certification and recorded in a certification report.
- 1.2.3.3. Requirements
 - 1.2.3.3.1. When the lower legform impactor is used for a test as specified in paragraph 1.2.3.4., the maximum bending moment of the tibia at tibia-1 shall be not more than 272 Nm and not less than 235 Nm, the maximum bending moment at tibia-2 shall be not more than 211 Nm and not less than 185 Nm, the maximum bending moment at tibia-3 shall be not more than 160 Nm and not less than 135 Nm, and the maximum bending moment at tibia-4 shall be not more than 108 Nm and not less than 94 Nm. The maximum elongation of MCL shall be not more than 26 mm and not less than 23 mm, the maximum elongation of ACL shall be not more than 11 mm and not less than 9.0 mm, and the maximum elongation of PCL shall be not more than 5.4 mm and not less than 4.0 mm.

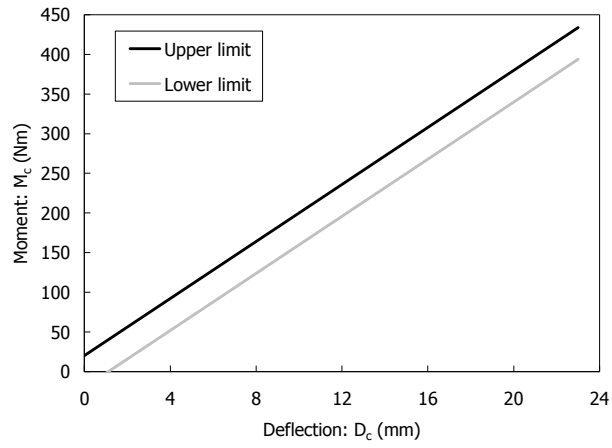
For all these values, the readings used shall be from the initial impact timing to 250 ms after the impact timing.
 - 1.2.3.3.2. The instrumentation response value CFC, as defined in ISO 6487:2002, shall be 180 for all transducers. The CAC response values, as defined in ISO 6487:2002, shall be 30 mm for the knee ligament elongations and 400 Nm for the tibia bending moments. This does not require that the impactor itself be able to physically elongate and bend to these values.
- 1.2.3.4. Test procedure
 - 1.2.3.4.1. The impactor, including flesh, shall be suspended from the dynamic certification test rig 15 ± 1 ° upward from the horizontal as shown in Figure 12. The impactor shall be released from the suspended position, whereupon the impactor falls freely against the pin joint of the test rig as shown in Figure 12.
 - 1.2.3.4.2. The knee joint centre of the impactor shall be 30 ± 1 mm below the bottom line of the stopper bar, and the tibia impact face shall be located 13 ± 1 mm from the front upper edge of the stopper bar when the stopper block is removed from the stopper bar and then hung from the impactor without any contact (see Figure 12).
- 1.2.4. Dynamic certification tests (inverse type)
 - 1.2.4.1. The lower legform impactor with flesh (femur, knee joint, and tibia are connected/assembled firmly) shall meet the requirements specified in paragraph 1.2.4.3. when tested as specified in paragraph 1.2.4.4.
 - 1.2.4.2. Certification
 - 1.2.4.2.1. The test facility used for the certification test shall have a stabilised temperature of 20 ± 2 °C during certification.

- 1.2.4.2.3. The temperature of the certification area shall be measured at the time of certification and recorded in a certification report.
- 1.2.4.3. Requirements
- 1.2.4.3.1. When the lower legform impactor is used for the test specified in paragraph 1.2.4.4., the maximum bending moment of the tibia at tibia-1 shall be not more than 277 Nm and not less than 237 Nm, the maximum bending moment at tibia-2 shall be not more than 269 Nm and not less than 223 Nm, the maximum bending moment at tibia-3 shall be not more than 204 Nm and not less than 176 Nm, and the maximum bending moment at tibia-4 shall be not more than 120 Nm and not less than 98 Nm. The maximum elongation of the MCL shall be not more than 23 mm and not less than 18 mm, that of the ACL shall be not more than 10.5 mm and not less than 8.5 mm, and that of the PCL shall be not more than 6 mm and not less than 4.5 mm.
- For all these values, the readings used shall be from the initial impact timing to 50 ms after the impact timing.
- 1.2.4.3.2. The instrumentation response value CFC, as defined in ISO 6487:2002, shall be 180 for all transducers. The CAC response values, as defined in ISO 6487:2002, shall be 30 mm for the knee ligament elongations and 400 Nm for the tibia bending moments. This does not require that the impactor itself be able to physically elongate and bend to these values.
- 1.2.4.4. Test procedure
- 1.2.4.4.1. The fully assembled FlexPLI (with flesh and skin) shall be stationary suspended vertically from a test rig as shown in Figure 13. It is then impacted by the upper edge of a linearly guided Al honeycomb impactor, covered by a thin (less than 1 mm thickness) paper cloth, at an impact speed of $11,1 \pm 0,2$ m/s. The legform is to be released from the test rig within 10 ms after the time of first contact to ensure a free flight condition.
- 1.2.4.4.2. The honeycomb of 5052 alloy, which is attached in front of the moving ram, shall have a crash strength of 75 ± 10 per cent psi and dimensions of $w = 200 \pm 2$ mm, $l = 160 \pm 2$ mm and $d = 60 \pm 5$ mm. To ensure a consistent and good level of repeatability, the honeycomb should either have a 3/16 inches cell size in combination with a density of 3.1 pcf or a 1/4 inches cell size in combination with a density of 2.3 pcf or a 3/16 inches cell size in combination with a density of 2.0 pcf.
- 1.2.4.4.3. The upper edge of the honeycomb face is to be in line with the rigid plate of the linearly guided impactor. At time of first contact, the upper edge of the honeycomb is to be in line with the knee joint centre line within a vertical tolerance of 0 ± 2 mm. The honeycomb shall not be excessively handled or deformed before the impact test.
- 1.2.4.4.4. The FlexPLI pitch angle and therefore the pitch angle of the velocity vector of the honeycomb impactor (rotation around y-axis) at the time of first contact shall be within a tolerance of $0 \pm 2^\circ$ in relation to the lateral vertical plane. The FlexPLI roll angle and therefore the roll angle of the honeycomb impactor (rotation around x-axis) at the time of first contact shall be within a tolerance of $0 \pm 2^\circ$ in relation to the longitudinal vertical plane. The FlexPLI yaw angle and therefore the yaw angle of the velocity vector of the honeycomb impactor (rotation around z-axis) at the time of

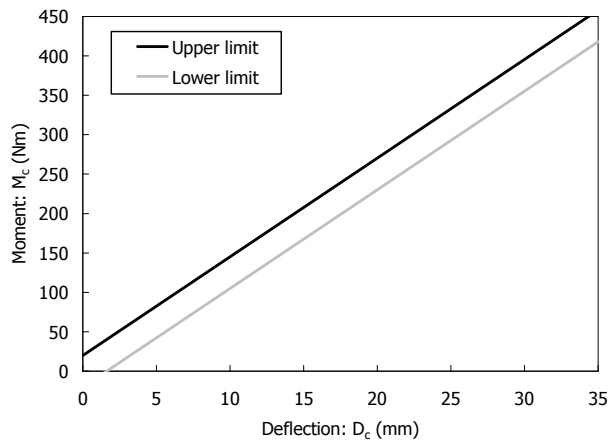
first contact shall be within a tolerance of $0\pm 2^\circ$, to ensure a correct operation of the knee joint.”

Insert new Figures 7 to 13 of Annex 6, to read:

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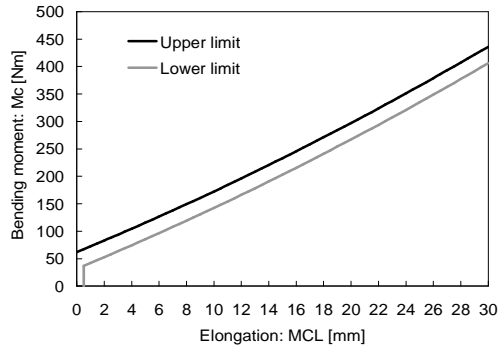


(a) Femur bending corridor

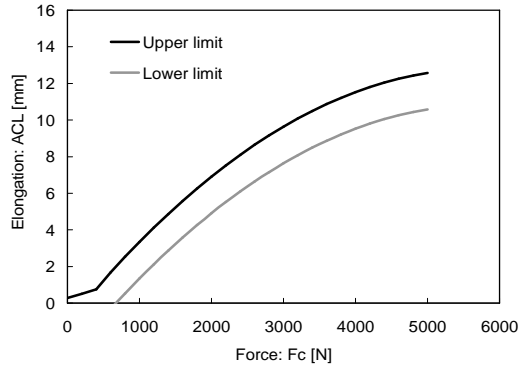


(b) Tibia bending corridor

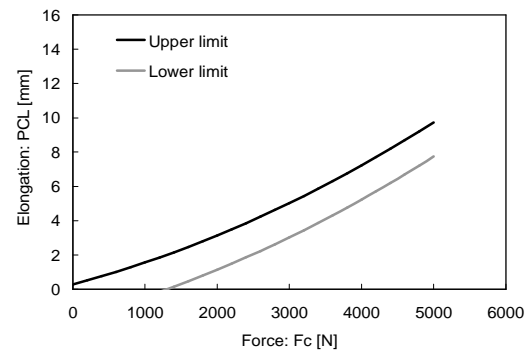
Figure 7: Requirement corridor of femur and tibia in static certification test (see paragraph 1.2.2.2.)



(a) for MCL

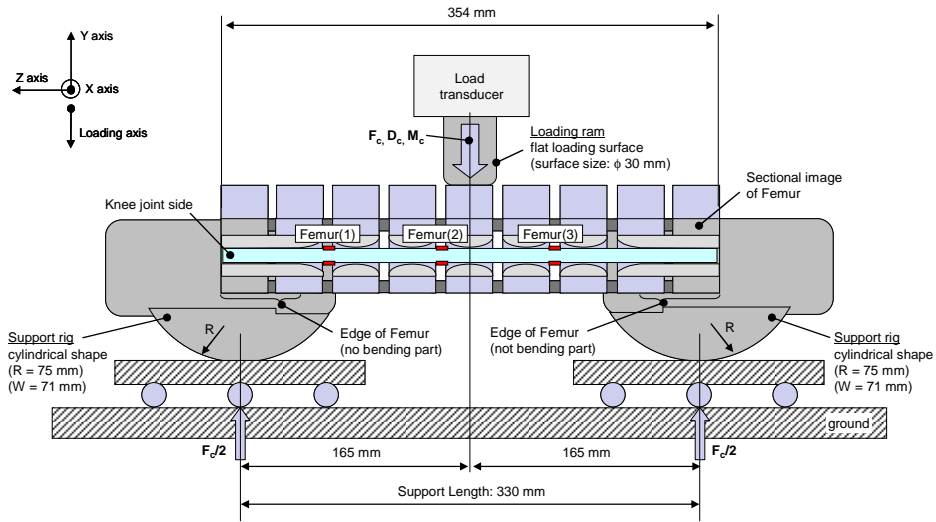


(b) for ACL



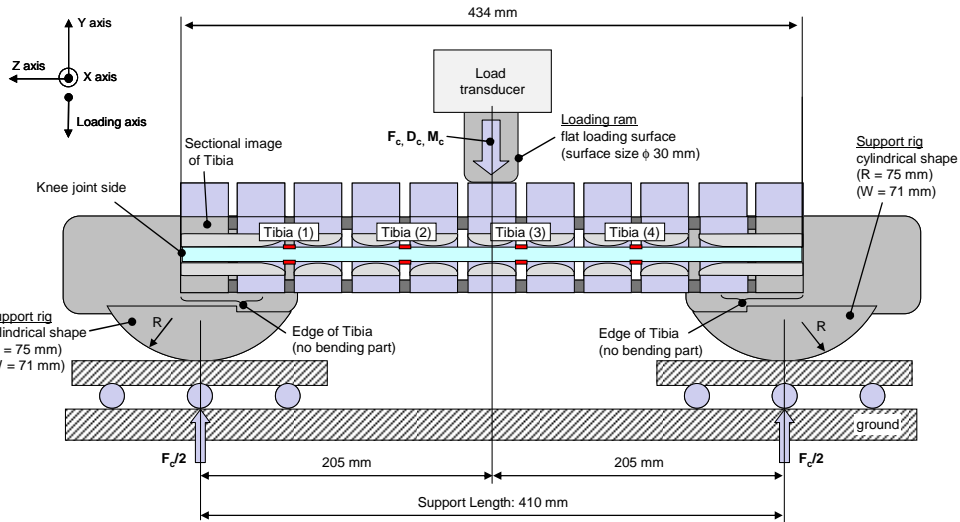
(c) for PCL

Figure 8: Requirement corridors for knee joint in static certification test (see paragraph 1.2.2.3.)



F_c : External loading force at center of the femur
 D_c : Deflection at center of the femur
 M_c : Moment Center (Nm) = $F_c/2$ (N) x 0.165 (m)
 R: Radius, W: Width along to the side axis

Figure 9: Test set-up for femur in static certification tests (see paragraph 1.2.2.4.)



F_c : External loading force at center of the tibia
 D_c : Deflection at center of the tibia
 M_c : Moment Center (Nm) = $F_c/2$ (N) x 0.205 (m)
 R: Radius, W: Width along to the side axis

Figure 10: Test set-up for tibia in static certification test (see paragraph 1.2.2.4.)

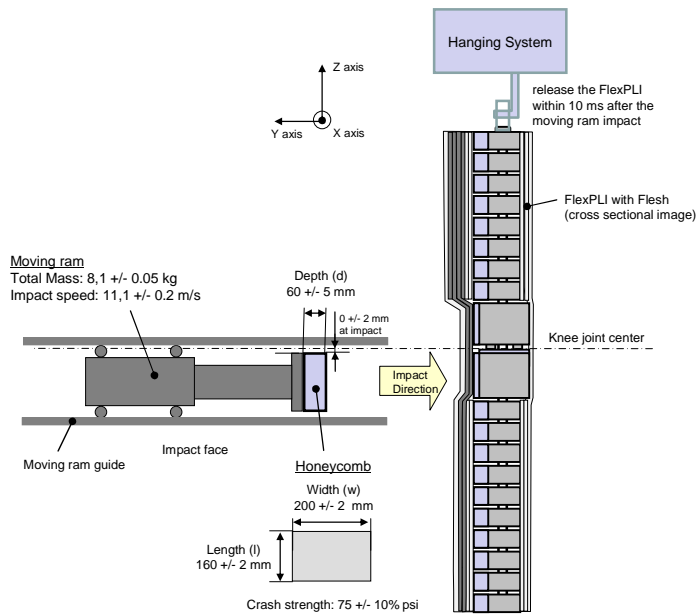


Figure 13: Test set-up for dynamic lower legform impactor certification test, Inverse type (see paragraph 1.2.4.4)."

Paragraph 2.4.6. of Annex 6, amend to read:

"... into the stationary pendulum as shown in Figure 714."

Paragraph 3.3.1. of Annex 6, amend to read:

"...suspended from a drop rig as shown in Figure 815."

Paragraph 3.3.3. of Annex 6, amend to read:

"... respect to the vertical as shown in Figure 715. The suspension of the ..."

Figures 7 and 8 (former) of Annex 6, renumber as Figures 14 and 15.

II. Justification

Based on the results of the TEG activities, the expert from Japan proposes the draft amendments of upcoming new ECE on pedestrian safety as mentioned above.

Paragraph 5.1.1: added FlexPLI requirements.

Insert New Paragraph 11. : Provide appropriate transitional provisions based on the 47th GRSP discussions.

Insert New Paragraph 7.of Annex 1 (part 2): To distinguish which lower legform impactor or both was utilized.

Paragraph 7.(former) to 15.(former) of Annex 1 (part 2): renumbering (editorial).

Paragraph 1. of Annex 4: added “s” to describe two different lower legform impactors following paragraph (editorial).

Insert New Paragraph 1.1.of Annex 4: clarification for which lower legform impactor information (editorial).

Paragraph 1.1. to 1.4.(former) of Annex 4: renumbering (editorial).

Paragraph 2. (former) of Annex 4: renumbering and clarification (editorial).

Paragraph 2.1. to 2.4. (former) of Annex 4: renumbering (editorial).

Title of Figure 1. of Annex 4: clarification (editorial).

Insert new paragraphs 1.3. to 1.4.4.: added Flex-PLI specifications.

Insert new Figures 2 to 6: added Flex-PLI figures.

Paragraph 3. to 3.7. (former) of Annex 4: renumbering (editorial).

Paragraph 3.1. (former): renumbering (editorial).

Paragraph 4. to 4.3. (former) of Annex 4: renumbering (editorial).

Paragraph 4.2. (former) of Annex 4: renumbering (editorial).

Figure 2. (former) of Annex 4: renumbering (editorial).

Paragraph 5. to 5.5. (former) of Annex 4: renumbering (editorial)

Paragraph 5.1. (former) of Annex 4: renumbering (editorial)

Paragraph 5.2.2. (former) of Annex 4: renumbering (editorial)

Figure 3. (former) of Annex 4: renumbering (editorial).

Paragraph 5.3. (former) of Annex 4: renumbering (editorial).

Figure 4. (former) of Annex 4: renumbering (editorial).

Paragraph 5.4.2. (former) of Annex 4: renumbering (editorial).

Paragraph 1. of Annex 5: added “s” to describe two different lower legform impactors following paragraph (editorial).

Insert New Paragraph 1.1. of Annex 5: add title (editorial).

Paragraph 1.1. to 1.12. (former) of Annex 5: renumbering (editorial).

Insert new paragraphs 1.2. to 1.2.4. of Annex 5: added Flex-PLI to bumper test procedure.

Insert new Figures 3 and 4. of Annex 5: added figures related to the Flex-PLI to bumper test procedure.

Paragraph 3.4.1. of Annex 5: renumbering (editorial).

Figure 3. of Annex 5: renumbering (editorial).

Paragraph 1. of Annex 6: added “s” to describe two different lower legform impactors following paragraph (editorial).

Paragraph 1.1. to 1.3.3.5. of Annex 6: renumbering (editorial).

Insert New Paragraph 1.1. of Annex 6: add title (clarification).

Insert new paragraphs 1.2. to 1.2.4.4.4. of Annex 6: added Flex-PLI certification method.

Insert new Figures 7 to 13. of Annex 6: added figures related to the Flex-PLI certification method.

Paragraph 2.4.6. of Annex 6: renumbering (editorial).

Paragraph 3.3.1. of Annex 6: renumbering (editorial).

Paragraph 3.3.3. of Annex 6: renumbering (editorial).

Figures 7 and 8 (former) of Annex 6: renumbering (editorial).
