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## Economic Commission for Europe

### Inland Transport Committee

### World Forum for Harmonization of Vehicle Regulations

#### 179th session

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Items 4.16.1 and 16 of the provisional agenda

#### 1958 Agreement:

**Proposals for amendments to Mutual Resolutions**

#### 1998 Agreement:

**consideration of amendments to Mutual Resolutions**

## **Proposal for Amendment 2 to Mutual Resolution No. 1 (MR.1) – Draft Addendum 3**

### **Submitted by the experts from the Working Party on Passive Safety\***

The text reproduced below was adopted by the Working Party on Passive Safety (GRSP) at its sixty-fifth session (ECE/TRANS/WP.29/GRSP/65, para. 7). It is based on ECE/TRANS/WP.29/GRSP/2019/4. It is submitted to the World Forum for Harmonization of Vehicle Regulations (WP.29) and to the Executive Committee of the 1998 Agreement (AC.3) for consideration at their November 2019 sessions.

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\* In accordance with the programme of work of the Inland Transport Committee for 2018–2019 (ECE/TRANS/274, para. 123 and ECE/TRANS/2018/21/Add.1, Cluster 3.1), the World Forum will develop, harmonize and update UN regulations to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.

## Proposal for Amendment 2 to Mutual Resolution No. 1 (MR.1) — Draft Addendum 3

*Contents*, amend to read:

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Addendum 3 - Specifications for the Construction, Preparation and Certification of the flexible Pedestrian Legform Impactor (FlexPLI).....	"

### Section II,

*Paragraphs 3. and 3.1., Specific provisions*, amend to read:

### "3. Specific provisions

- 3.1. The table below details the individual addenda to this Mutual Resolution in which details of the design, construction, maintenance and preparation of the test devices or equipment can be found.

<i>ECE/TRANS/WP.29/1101</i>	<i>Generic name of the Test Tool</i>	<i>Regulation(s) requiring the test Tool Device</i>	<i>Global technical regulation(s) requiring the Test Tool or Device</i>	<i>Date of adoption of the Addendum</i>
... - Addendum 1 to M.R.1	(Reserved) BioRID Dummy	...	...	...
Amend.1 - Addendum 2 to M.R.1	WorldSID 50 <sup>th</sup> male Dummy	No. 135	No. 14	12 Nov. 2014
Amend.2 - Addendum 3 to M.R.1	FlexPLI	No. 127	No. 9	

*Appendix*, amend to read:

"Addendum 1 – [Reserved for Bio Rear Impact Dummy (BioRID) specifications]

Addendum 2 – Specifications for the Construction, Preparation and Certification of the World Side Impact 50<sup>th</sup> percentile adult male anthropomorphic test device (WorldSID 50<sup>th</sup> male)

Addendum 3 – Specifications for the Construction, Preparation and Certification of the flexible Pedestrian Legform Impactor (FlexPLI)

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## 1. General provisions

- 1.1. This Addendum provides the specifications for the flexible Pedestrian Legform Impactor (FlexPLI) that is to be used for the testing of motor vehicles and their pedestrian safety performance. Detailed specifications for the design, certification and assembly/disassembly of FlexPLI are published on the website of the Informal Group on GTR No. 9 – Phase 2.
- 1.2. WP.29 introduced Phase 2 of the global technical regulation No. 9 on Pedestrian Safety in the 1998 Agreement and the 01 series to Regulation 127 which are on the approval of motor vehicles and their pedestrian safety performance under the 1958 Agreement. To ensure consistency in applying the test requirement in these regulations, it is imperative to include accurate information on the test devices in the reference material for the regulators, Type Approval Authorities and Technical Services.

## 2. General design

The flexible Pedestrian Legform Impactor is designed to represent anthropometry of the right leg of a 50th percentile male.

### 2.1. Physical properties

The flexible Pedestrian Legform Impactor shall consist of the flesh and skin, flexible long bone segments (representing femur bone and tibia bone), and the knee joint as shown in Figure 1.

The assembled impactor shall have a total mass of  $13.2 \pm 0.4$  kg. The dimensions of the fully assembled impactor shall be as defined in Figure 1, measured at the vertical centre line.

Brackets, pulleys, protectors, connection parts, etc. attached to the impactor for the purposes of launching and/or protection may extend beyond the dimensions and tolerances shown in Figures 1 and 2.

The cross-sectional shape of the femur main body segments, the tibia main body segments and their impact faces shall be as defined in Figure 2 (a).

The cross-sectional shape of the knee joint and its impact face shall be as defined in Figure 2 (b).

The masses of the femur and the tibia without the flesh and skin, including the connection parts to the knee joint, shall be  $2.46 \pm 0.12$  kg and  $2.64 \pm 0.13$  kg respectively. The mass of the knee joint without the flesh and skin shall be  $4.28 \pm 0.21$  kg. The assembled mass of the femur, the knee joint and the tibia without the flesh and skin shall be  $9.38 \pm 0.3$  kg. The screws that attach femur and tibia to the knee are part of the knee assembly.

The centres of gravity of (a) the femur and tibia without the flesh and skin, including the connection parts to the knee joint, and (b) the knee joint shall be as defined in Figure 1.

The moment of inertia of the femur and the tibia without the flesh and skin, including the connection parts inserted to the knee joint, around the X-axis through the respective centre of gravity shall be  $0.0339 \pm 0.0016$  kg/m<sup>2</sup> and  $0.0486 \pm 0.0023$  kg/m<sup>2</sup> respectively. The moment of inertia of the knee joint around the X-axis through the respective centre of gravity shall be  $0.0180 \pm 0.0009$  kg/m<sup>2</sup>.

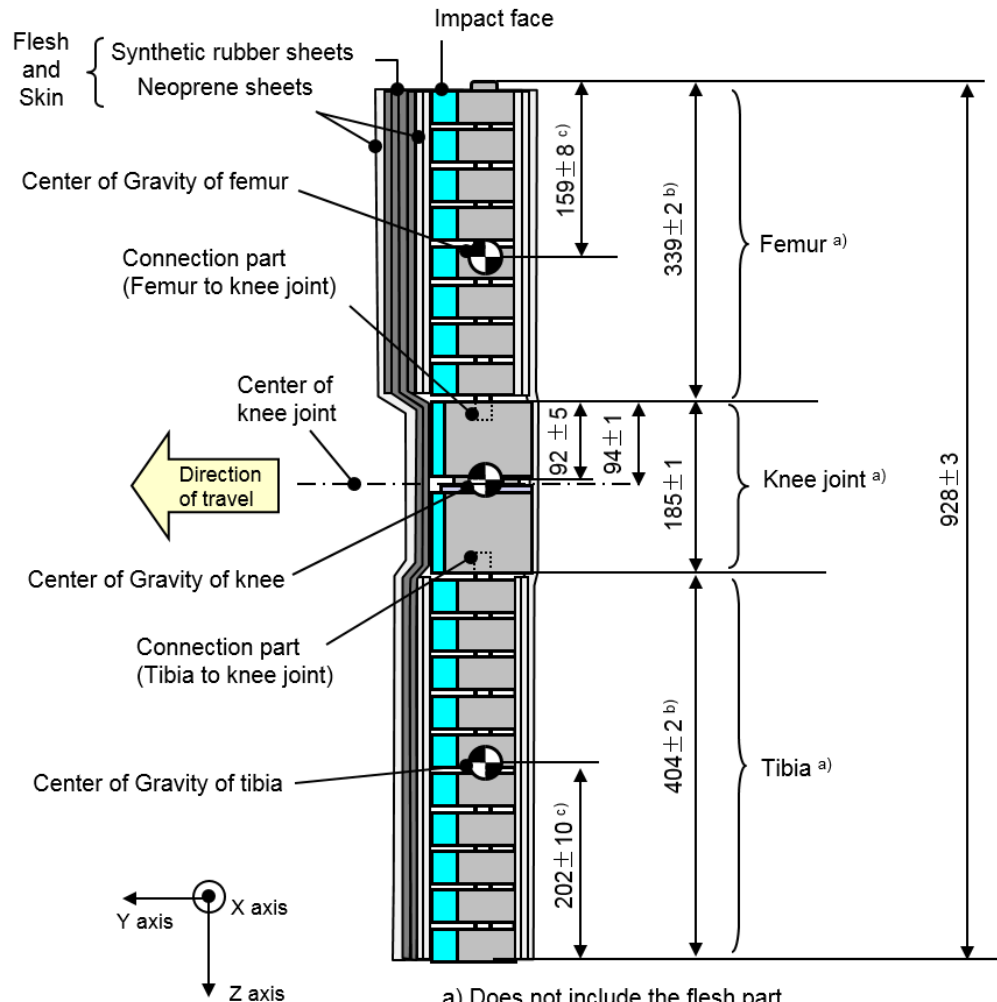
For each test, the impactor (femur, knee joint and tibia without flesh and skin) shall be covered by the flesh and skin composed of synthetic rubber sheets (R1, R2) and foamed neoprene sheets (N1F, N2F, N1T, N2T, N3) as shown in Figure 3. The size of the sheets shall be within the requirements shown in Figure 3. The sheets are required to have compression characteristics as shown

in Figure 4. The compression characteristics shall be checked using material from the same batch as the sheets used for the impactor flesh and skin.

Figure 1

**Flexible Pedestrian Legform Impactor: Dimensions and centre of gravity locations of femur, knee joint and tibia (side view)**

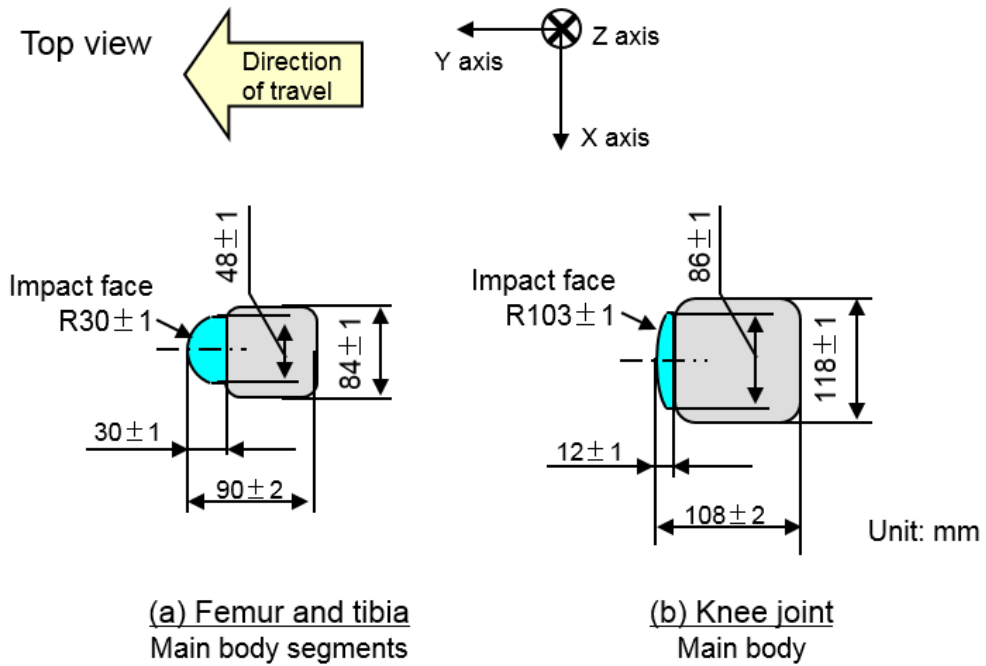
Side view



- a) Does not include the flesh part  
 b) Exclude the connection part length to the knee joint  
 c) Center of Gravity (C.G.) locations of femur, knee, and tibia without flesh (Included the connection part mass to the femur and tibia C.G. calculation)

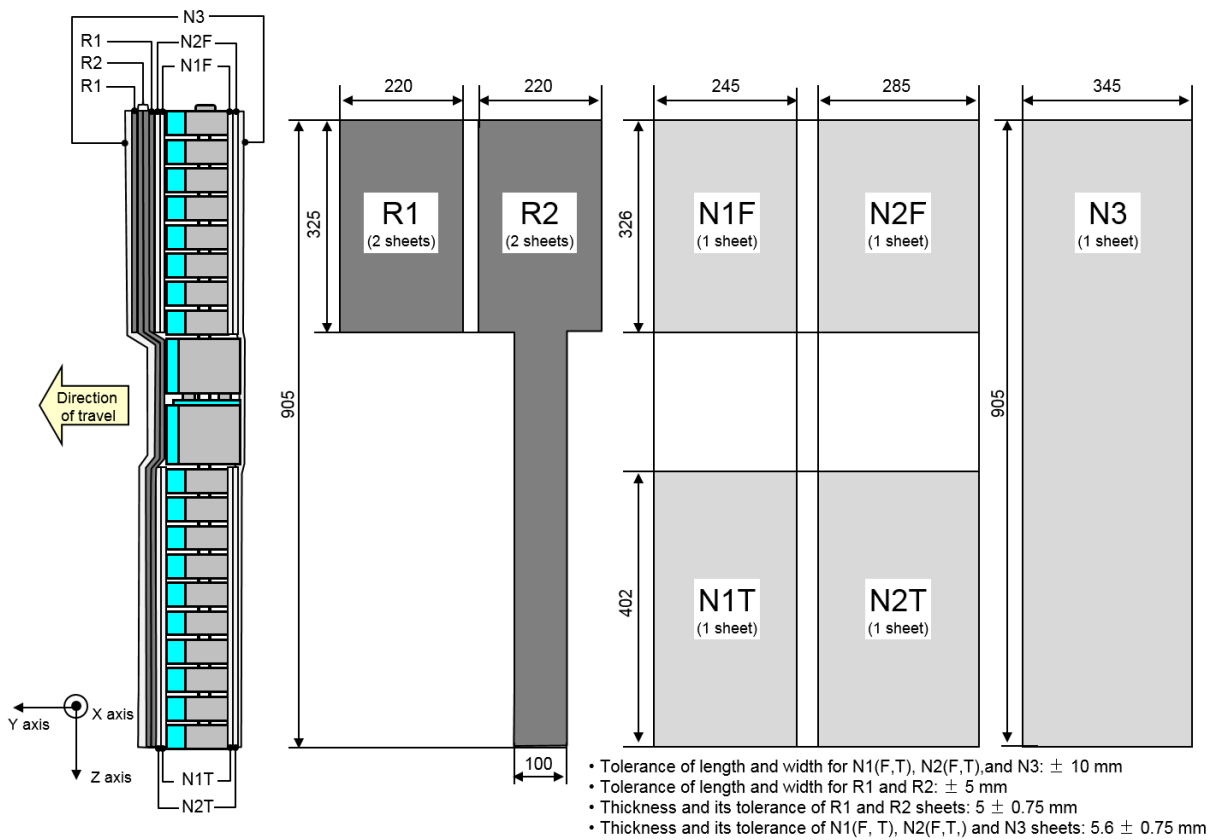
[all dimensions in mm]

Figure 2  
**Flexible Pedestrian Legform Impactor: Schematic plan views of femur, tibia and knee dimensions (top view, main body segments)**



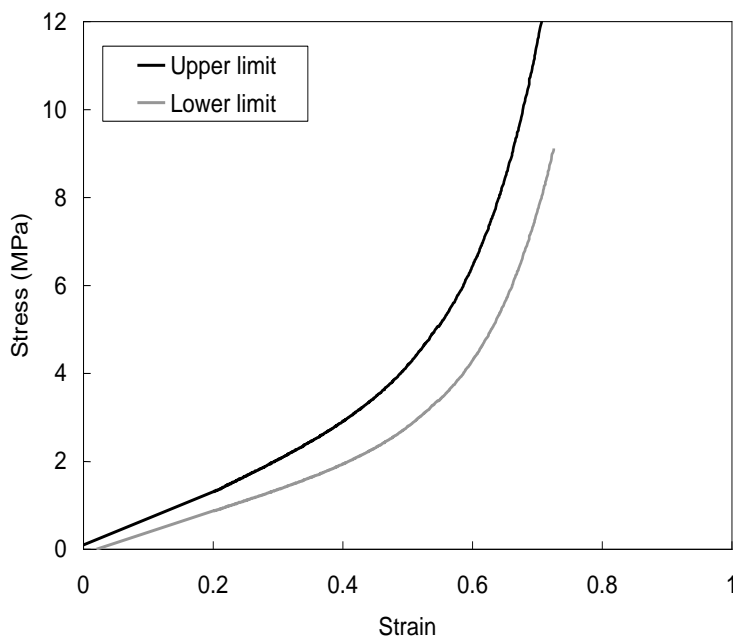
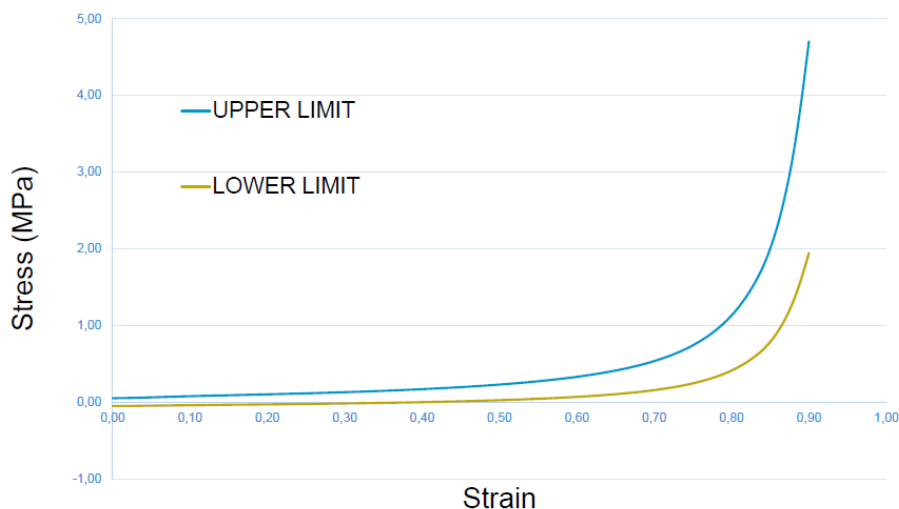
[all dimensions in mm]

Figure 3  
**Flexible Pedestrian Legform Impactor: Flesh and skin dimensions**



[all dimensions in mm]

Figure 4

**Flexible Pedestrian Legform Impactor: Flesh and skin compression characteristics****(a) Synthetic rubber sheets****(b) Foamed neoprene sheets****2.2. Instrumentation**

The FlexPLI shall be equipped with at least the following instrumentation:

Four transducers shall be installed on the tibia bone core to measure bending moments at locations within the tibia part of the flexible Pedestrian Legform Impactor.

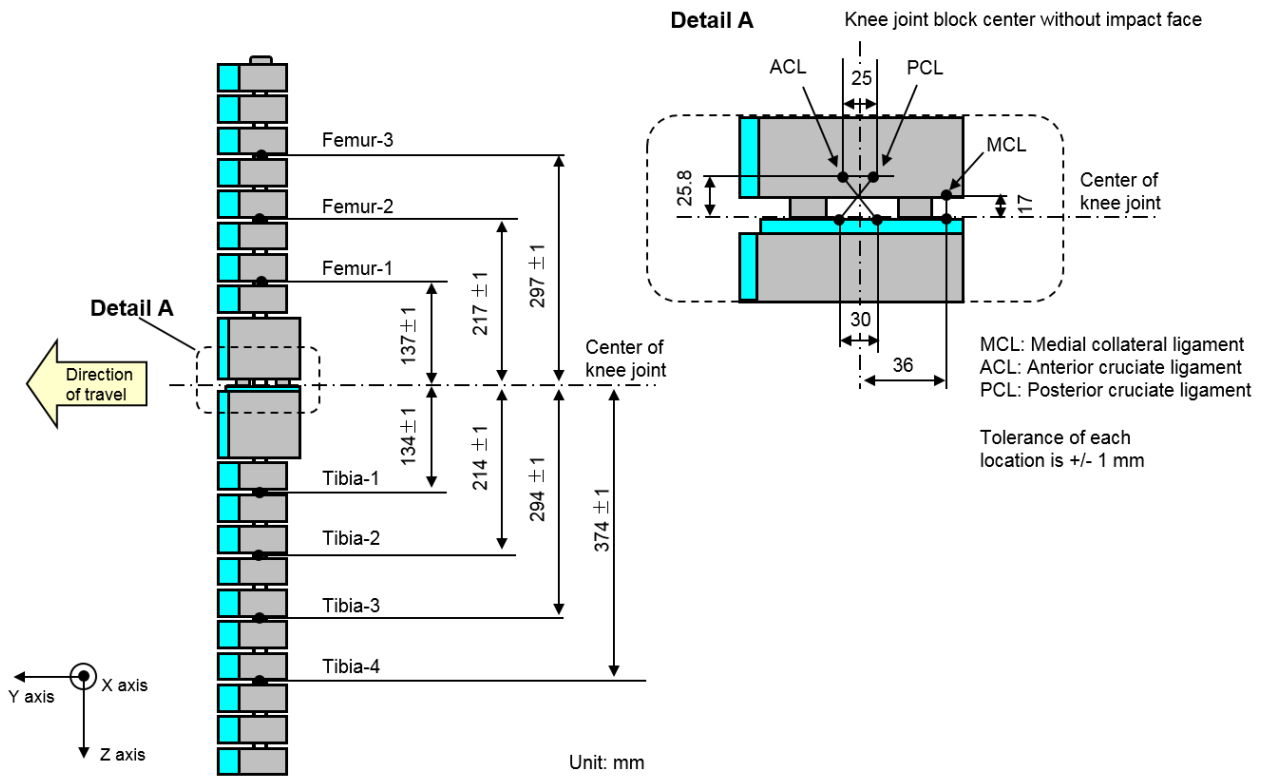
Three transducers shall be installed in the femur to measure bending moments applied to the femur. The sensing locations of each of the transducers are as defined in Figure 5.

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 5. The measurement locations shall be within  $\pm 4$  mm along the X-axis from the knee joint centre.

The FlexPLI may offer a range of additional optional instrumentation for research purposes. Such instrumentation is no part of the requirements set forth in UN Regulations.

The instrumentation response value Channel Frequency Class (CFC), as defined in ISO 6487:2002, shall be 180 for all transducers. The Channel Amplitude Class (CAC) response values, as defined in ISO 6487:2002, shall be 30 mm for the knee ligament elongations and 400 Nm for the tibia and femur bending moments. This does not require that the impactor itself is able to physically elongate or bend until these values.

Figure 5  
Flexible Pedestrian Legform Impactor: Location of the transducers



[all dimensions in mm]

### 3. Assembly and disassembly

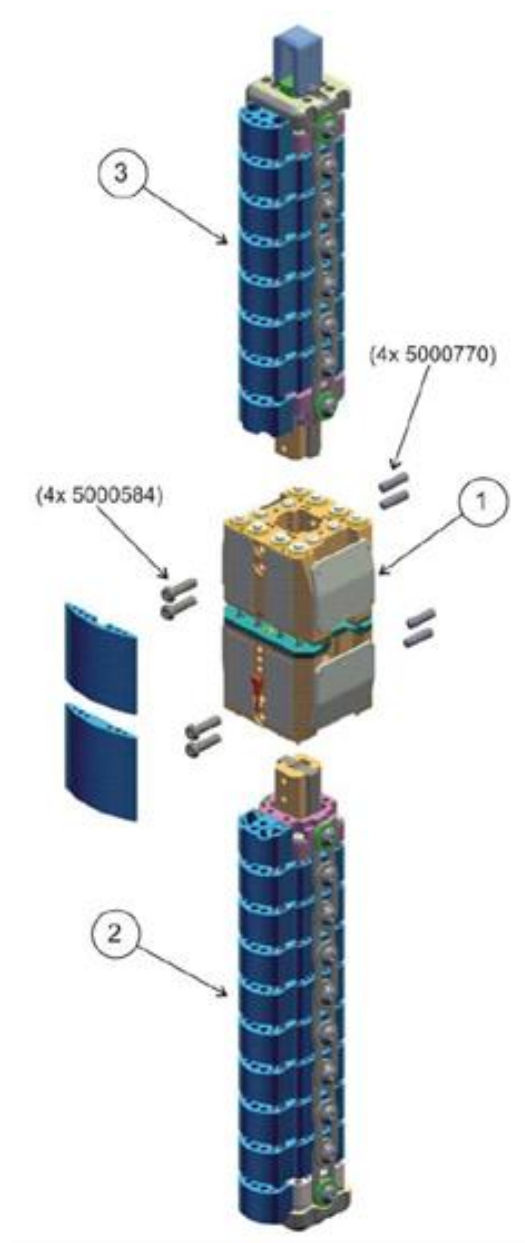
The assembly and disassembly are described in detail in the FlexPLI user manual.<sup>1</sup>

The exploded view of the FlexPLI is shown in Figure 6.

<sup>1</sup> The user manual is available on the website of the Mutual Resolution No. 1 (M.R.1) of the 1958 and the 1998 Agreements: [www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html)



Figure 6  
Exploded view of legform assembly (1 - Knee assembly, 2 – Tibia assembly, 3 – Femur assembly)



#### 4. Maintenance

The FlexPLI which passes the certification tests is the main indicator that the impactor is suitable for continued testing. If the FlexPLI does not pass, this would indicate that wear or damage has taken place and that the problem needs to be investigated and corrected.

Any parts which became cracked and/or worn and the damages that may have an influence on the testing or test results shall be replaced.

Maintenance is described in detail in the FlexPLI user manual. <sup>1</sup>

## 5. Certification

### 5.1. Static certification tests

The stabilized 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 4 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.

#### 5.1.1. The femur and the tibia of the flexible Pedestrian Legform Impactor shall meet the following:

The edges of the femur and tibia, without flesh and skin, non-bending parts, shall be mounted to the support rig firmly as shown in Figures 9 and 10. The Y-axis of the impactor shall be parallel to the loading axis within  $180 \pm 2^{\circ}$  tolerance. To obtain repeatable loading, low friction Polytetrafluoroethylene (PTFE) plastic pads are used under each support (see Figures 9 and 10).

The centre of the loading force shall be applied at the centre of the femur and the tibia within  $\pm 2\text{mm}$  tolerance along the Z-axis. The force shall be increased so as to maintain a deflection rate between 10 and 100 mm/minute until the bending moment at the centre part ( $M_c$ ) of the femur or tibia reaches 380 Nm.

During this test, the applied moment and the generated deflection at the centre of the femur and the tibia ( $M_c$  and  $D_c$ ) shall be within the corridors shown in Figure 7.

#### 5.1.2. The knee joint of the flexible Pedestrian Legform Impactor shall meet the following:

The ends of the knee joint, without flesh and skin, 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  $\pm 2^{\circ}$  tolerance. To obtain repeatable loading, low friction Polytetrafluoroethylene (PTFE) plastic pads are used under each support (see Figure 11). To avoid impactor damage, a foamed neoprene sheet shall be set between the loading ram and the impactor face of the knee joint, which is described in Figure 11, shall be removed. The foamed neoprene sheet used in this test shall have compression characteristics as shown in Figure 4.

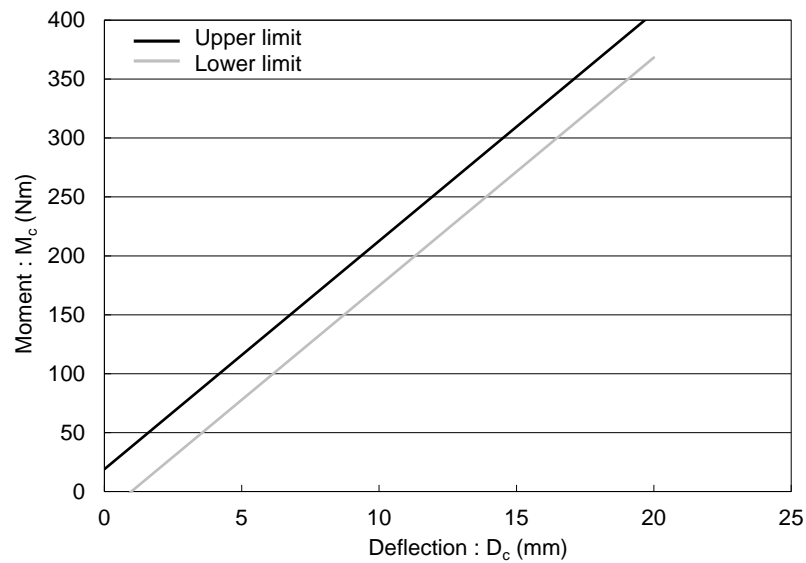
The centre of the loading force shall be applied at the knee joint centre within  $\pm 2^{\circ}\text{mm}$  tolerance along the Z-axis (see Figure 1). The external load shall be increased so as to maintain a deflection rate between 10 and 100 mm/minute until the bending moment at the centre part of the knee joint ( $M_c$ ) reaches 400 Nm.

During this test, MCL, ACL and PCL elongations and applied bending moment or the force at the centre of the knee joint ( $M_c$  or  $F_c$ ) shall be within the corridors shown in Figure 8.

Figure 7

**Flexible Pedestrian Legform Impactor: Requirement corridors of the femur and the tibia, without flesh and skin, in the static certification test**

**(a) Femur bending moment corridor**



**(b) Tibia bending moment corridor**

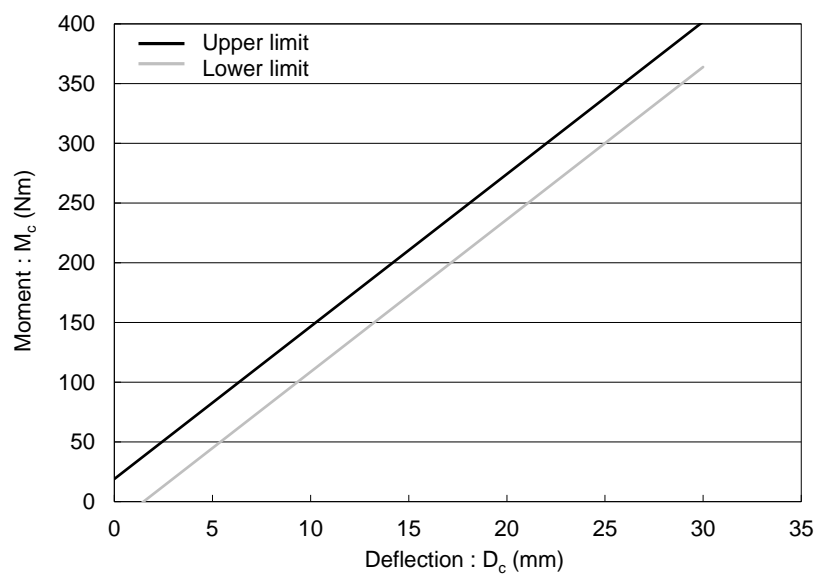
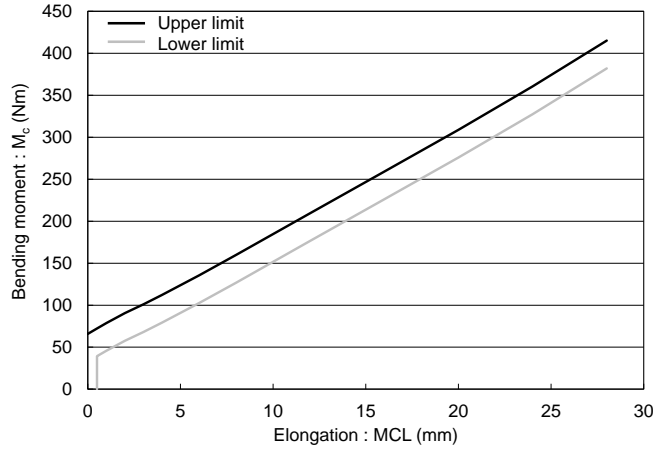
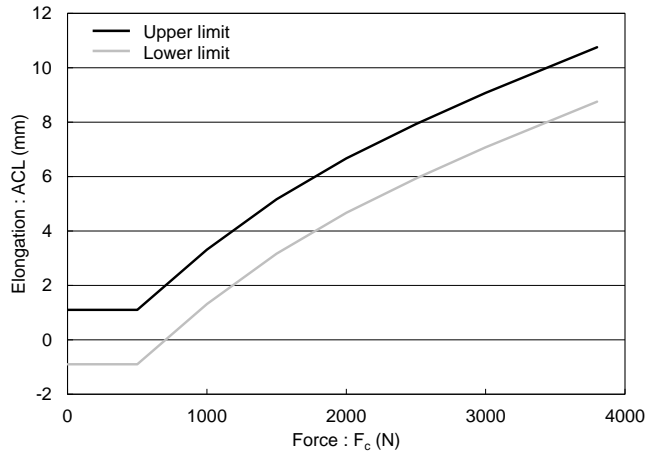


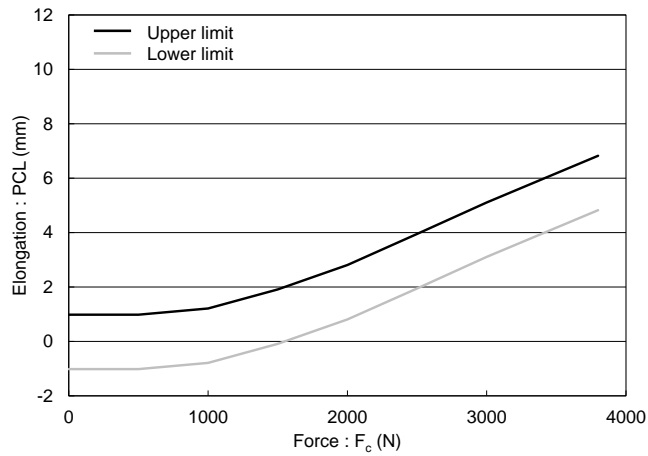
Figure 8  
**Flexible Pedestrian Legform Impactor: Requirement corridors for the knee joint, without flesh and skin, in the static certification test (see paragraph 8.1.1.3.)**



(a) for MCL



(b) for ACL



(c) for PCL

Figure 9  
**Flexible Pedestrian Legform Impactor: Test set-up for the femur in the static certification test**

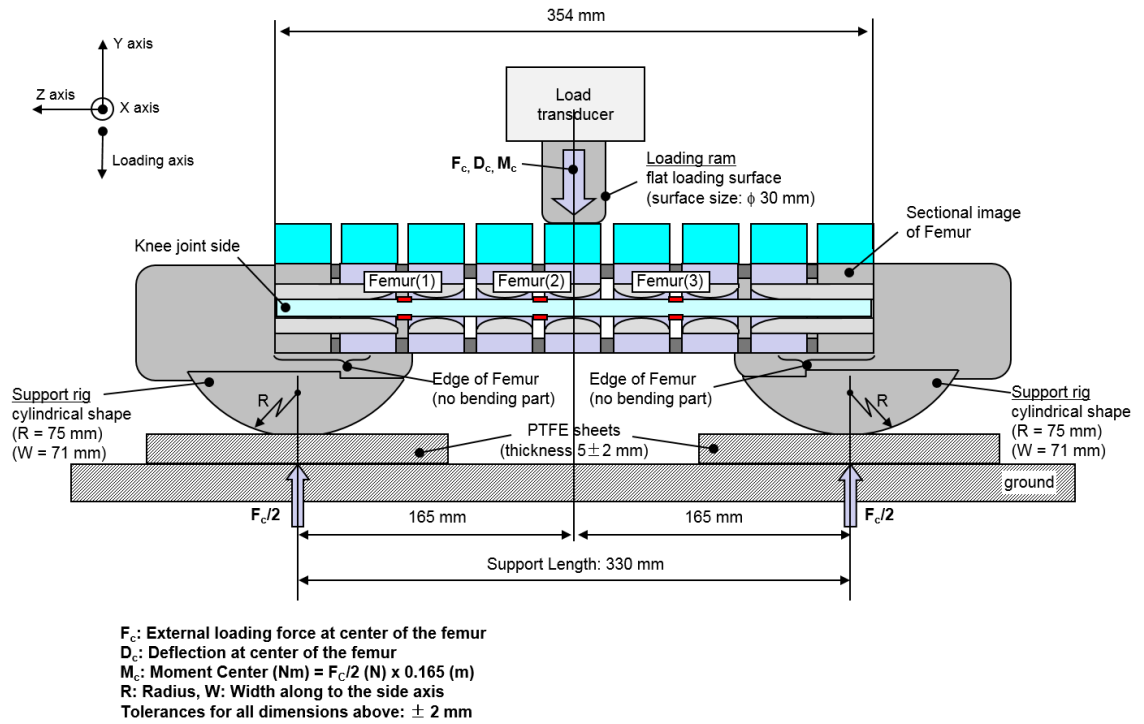


Figure 10  
**Flexible Pedestrian Legform Impactor: Test set-up for the tibia in the static certification test**

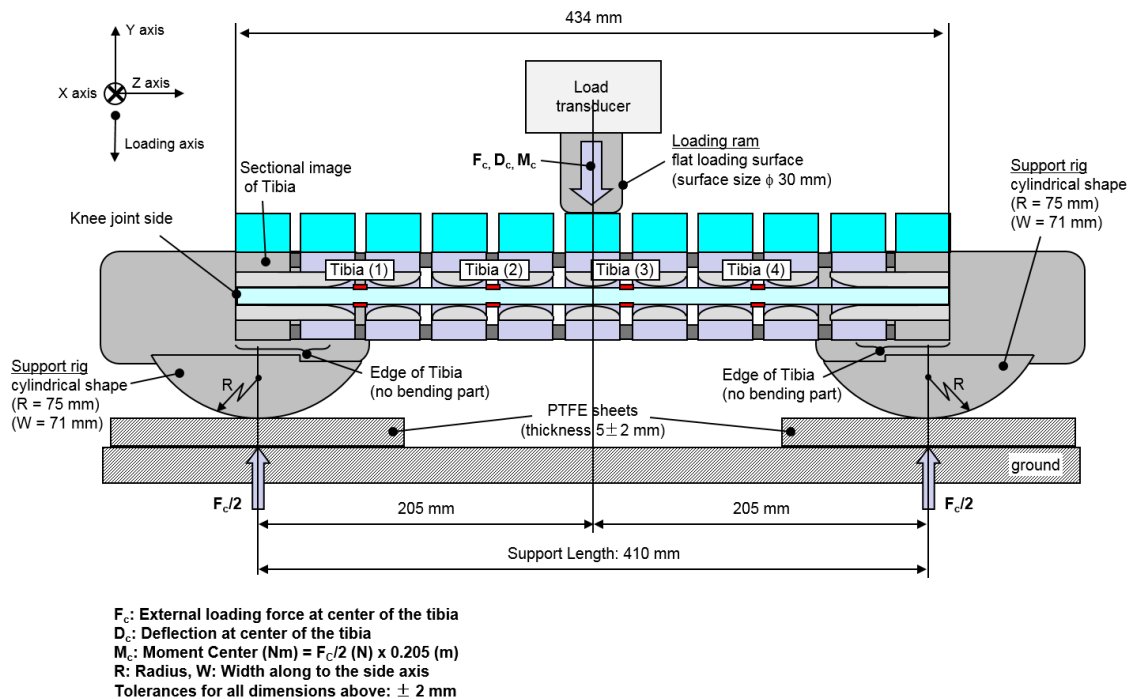
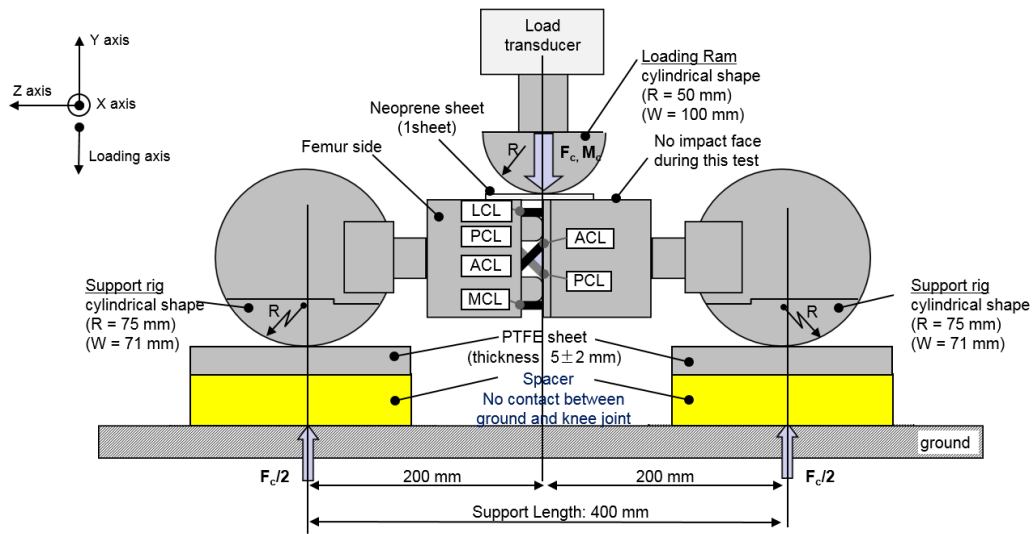
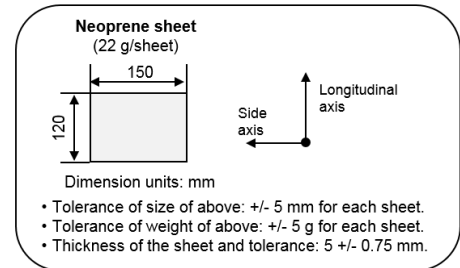


Figure 11  
**Flexible Pedestrian Legform Impactor: Test set-up for the knee joint in the static certification test**



$F_c$ : External loading force at center of knee joint  
 $M_c$ : Moment center (Nm) =  $F_c/2$  (N) x 0.2 (m)  
 $R$ : Radius,  $W$ : Width along to the side axis  
 Tolerances for all dimensions above:  $\pm 2$  mm



5.2. Dynamic certification tests (pendulum test)

The test facility used for the certification test shall have a stabilized temperature of  $20 \pm 2$  °C during the test.

The temperature of the certification area shall be measured at the time of certification and recorded in a certification report.

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 is able to physically elongate or bend until these values.

5.2.1. The assembled flexible Pedestrian Legform Impactor shall meet the following:

As shown in Figure 12, the flexible Pedestrian Legform Impactor, including the flesh, skin and the additional mass, shall be suspended from the dynamic certification test rig  $15 \pm 1^\circ$  upward from the horizontal. The impactor shall be released from the suspended position and fall freely against the pin joint of the test rig.

The knee joint centre of the impactor shall be  $30 \pm 1$  mm below the bottom line of the stopper bar, and the tibia impact face without the flesh and skin shall be located  $13 \pm 2$  mm from the front upper edge of the stopper bar when the impactor is hanging freely as shown in Figure 12.

When tested, the absolute value of the maximum bending moment of the tibia shall be:

- (a)  $235 \text{ Nm} \leq 272 \text{ Nm}$  at tibia-1;
- (b)  $187 \text{ Nm} \leq 219 \text{ Nm}$  at tibia-2;

- (c)  $139 \text{ Nm} \leq 166 \text{ Nm}$  at tibia-3;
- (d)  $90 \text{ Nm} \leq 111 \text{ Nm}$  at tibia-4.

The absolute value of the maximum elongation shall be:

- (a)  $20.5 \leq 24.0 \text{ mm}$  of MCL;
- (b)  $8.0 \leq 10.5 \text{ mm}$  of ACL;
- (c)  $3.5 \leq 5.0 \text{ mm}$  of PCL.

For all these values for the maximum bending moment and the maximum elongation, the readings used shall be from the initial impact timing to 200 ms after the impact timing.

### 5.3. Dynamic certification tests (inverse test)

The test facility used for the certification test shall have a stabilized temperature of  $20 \pm 2 \text{ }^\circ\text{C}$  during the test.

The temperature of the certification area shall be measured at the time of certification and recorded in a certification report.

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.

#### 5.3.1. The assembled flexible Pedestrian Legform Impactor shall meet the following:

The assembled flexible Pedestrian Legform Impactor (with the flesh and skin) shall be hung vertically and freely suspended from a test rig as shown in Figure 13. It is then impacted by the upper edge of a linearly guided aluminium honeycomb impactor, covered by a thin paper cloth with a maximum thickness of 1 mm, at an impact speed of  $11.1 \pm 0.2 \text{ m/s}$ . The legform shall achieve a free flight condition within 10 ms after the time of first contact of the honeycomb impactor.

The honeycomb of 5052 alloy, which is attached in front of the moving ram, shall be  $200 \pm 5 \text{ mm}$  wide,  $160 \pm 5 \text{ mm}$  high and  $60 \pm 2 \text{ mm}$  deep and shall have a crush strength of  $517.1 \text{ kPa} \pm 10 \text{ per cent}$  (75 pound per square inch (psi)  $\pm 10 \text{ per cent}$ ). The honeycomb should have cell sizes of either 4.76 mm (3/16 inch) or 6.35 mm (1/4 inch) and a density of  $32.0 \text{ kg/m}^3$  (2.0 pound per cubic foot (pcf)) for the 4.76 mm (3/16 inch) cell size or a density of  $36.8 \text{ kg/m}^3$  (2.3 pound per cubic foot (pcf)) for the 6.35 mm (1/4 inch) cell size.

The upper edge of the honeycomb face shall be in line with the rigid plate of the linearly guided impactor. At the time of first contact, the upper edge of the honeycomb shall be in line with the knee joint centre line within a vertical tolerance of  $\pm 2 \text{ mm}$ . The honeycomb shall not be deformed before the impact test.

At the time of the first contact, the flexible Pedestrian Legform Impactor pitch angle (rotation around the Y-axis) and, therefore, the pitch angle of the velocity vector of the honeycomb impactor shall be within a tolerance of  $\pm 2^\circ$  in relation to the lateral vertical plane. The flexible Pedestrian Legform Impactor roll angle (rotation around the X-axis) and, therefore, the roll angle of the honeycomb impactor shall be within a tolerance of  $\pm 2^\circ$  in relation to the longitudinal vertical plane. The flexible Pedestrian Legform Impactor yaw angle (rotation around the Z-axis) and, therefore, the yaw angle of the velocity vector of the honeycomb impactor shall be within a tolerance of  $\pm 2^\circ$ .

When tested, the absolute value of the maximum bending moment of the tibia shall be:

- (a)  $230 \text{ Nm} \leq 272 \text{ Nm}$  at tibia-1;
- (b)  $210 \text{ Nm} \leq 252 \text{ Nm}$  at tibia-2;

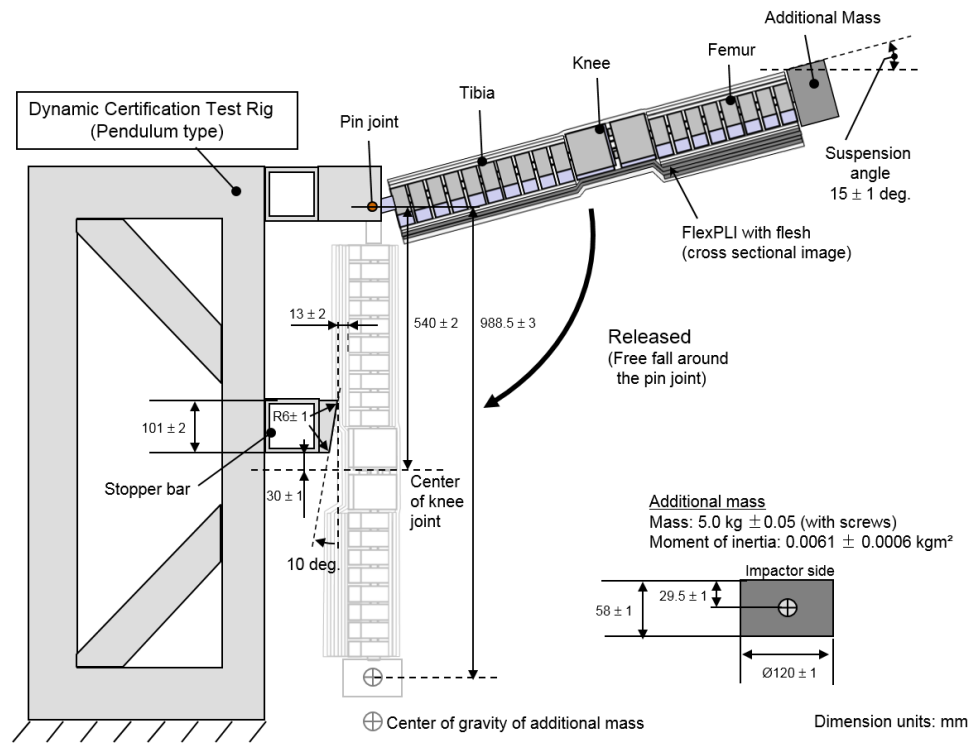
- (c)  $166 \text{ Nm} \leq 192 \text{ Nm}$  at tibia-3;
- (d)  $93 \text{ Nm} \leq 108 \text{ Nm}$  at tibia-4.

The absolute value of the maximum elongations shall be:

- (a)  $17.0 \leq 21.0 \text{ mm}$  of MCL;
- (b)  $8.0 \leq 10 \text{ mm}$  of ACL;
- (c)  $4.0 \leq 6.0 \text{ mm}$  of PCL.

For all these values for the maximum bending moment and the maximum elongation, the readings used shall be from the initial impact timing to 50 ms after the impact timing.

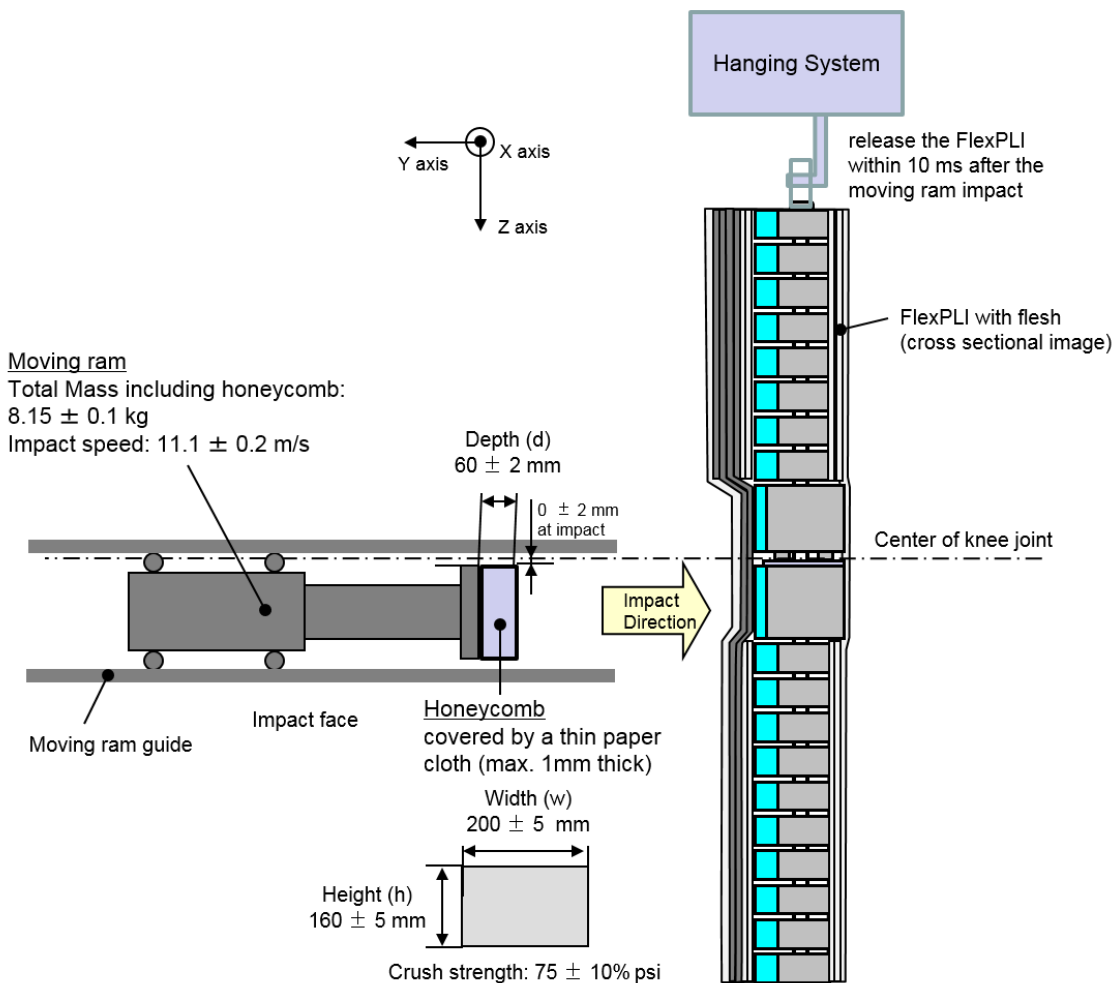
Figure 12  
**Flexible Pedestrian Legform Impactor: Test set-up for the dynamic Pedestrian Legform Impactor certification test (pendulum test)**



[all dimensions in mm]



Figure 13  
**Flexible Pedestrian Legform Impactor: Test set-up for the dynamic Pedestrian Legform Impactor certification test (inverse test)**



5.4 Certification procedures are described in detail in the FlexPLI user manual.<sup>1</sup>

## Annexes

### 1. Engineering drawings

Table 1

#### Drawing revisions

*Note:* This table lists all drawing revisions that are entered in detail in any of the following Appendices.

<i>Drawing Ref</i>	<i>Appendix / Table</i>	<i>Title</i>	<i>Description of change</i>
TRANS/WP.29/1101/Add.1/...			
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Table 2  
**Parts "and drawings" index**

*Note:* Drawing revisions should be entered immediately after the drawing they replace. The revision is also recorded in the Table 1, "Drawing Revisions".

<i>ECE/TRANS/WP.29/1 101/Add.3/...<sup>2</sup></i>	<i>Part Number</i>	<i>Description</i>	<i>Drwg Revision</i>	<i>No of Sheets</i>	<i>Qty per Assy</i>	<i>Qty per Leg</i>	<i>Common with Addenda( s)</i>
Drng 1	133-5000	FlexPLI Instrumented Leg	A	1			
Drng 10	133-5013	Cover Inner Femur	A	1	1	1	
Drng 11	133-5014	Cover Outer Femur	A	1	1	1	
Drng 12	133-5015	Cover Inner Tibia	A	1	1	1	
Drng 13	133-5016	Cover Outer Tibia	A	1	1	1	
Drng 14	133-5017	Cover FlexPLI	A	1	1	1	
Drng 16	133-5019	Hook and Loop Tie	A	1	6	6	
Drng 17	133-5020	Buffer Sheet Assembly Leg	A	1	1	1	
Drng 7	133-5010	Buffer Femur	A	1	2	2	
Drng 8	133-5011	Buffer Leg	A	1	2	2	
		Double Sided carpet Tape 20 mm wide			A/R	A/R	
Drng 26	133-5100	Femur Assembly	A	2	1	1	
Drng 38	133-5165	PCB Bone Assembly Femur	B	2	1	1	
		ID Chip			4	12	
		Resistor 150 Ohm 1/16W 0.1% 0603 SMD			8	16	
		Resistor 200 Ohm 1/16W 0.1% 0603 SMD			8	16	
		Ribbon Cable			A/R	A/R	
		Cable Tie 2-7/8-inches			1	2	
		Connector 16 Pin Circular Male w/Latch			1	2	
	734-2008	Backshell 16 Pin Circular w/Latch			1	2	
Drng 34	133-5109	Tape Acrylic Foam	A	1	1	2	
Drng 27	133-5101	Femur Bone	B	1	1	1	
		Strain Gage (350 Ohm)					
Drng 67	133-5508	Bone Clamp Thin Knee	A	1	1	2	
Drng 62	133-5503	Bone Clamp Thin Femur/Tibia	A	1	1	2	
Drng 65	133-5506	Bone Clamp Thick Knee	A	1	1	2	
Drng 61	133-5502	Bone clamp Thick Femur/Tibia	A	1	1	2	
Drng 64	133-5505	Spacer Bone Contact Thick	B	1	5	12	
Drng 63	133-5504	Shim Bone Clamp (0.4 Thick) optional	A	1	A/R	A/R	
Drng 69	133-5510	Rubber Buffer Femur/Tibia End	A	1	1	2	
Drng 66	133-5507	Spacer Bone Contact Thin	B	1	5	12	
Drng 68	133-5509	Shim (0.4 Thick) optional	A	1	A/R	A/R	
Drng 73	133-5514	Inner Segment Knee	A	1	1	2	
Drng 86	133-5535	Inner Segment Assy Closest to Knee	B	1	1	2	
Drng 71	133-5512	Rubber Buffer	A	1	4	32	
Drng 72	133-5513	Inner Segment	A	1	1	14	
Drng 85	133-5534	Inner segment Assembly	B	1	5	12	
Drng 71	133-5512	Rubber Buffer	A	1	2	32	
Drng 72	133-5513	Inner Segment	A	1	1	14	
		Screw BHCS M6 x 18 Zinc Plated			28	60	
	133-5515	Link	A	1	14	32	
Drng 33	133-5108	Segment Top Femur	A	1	1	1	
Drng 28	133-5102	Plate Top	A	1	1	1	
Drng 29	133-5103	Launch Guide	A	1	1	1	
Drng 30	133-5104	Washer 12 ID x 26 OD x 3	A	1	4	8	

<sup>2</sup> All drawings may be consulted on the website of M.R.1.:  
[www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html)

<i>ECE/TRANS/WP.29/1 101/Add.3/...<sup>2</sup></i>	<i>Part Number</i>	<i>Description</i>	<i>Drwg Revision</i>	<i>No of Sheets</i>	<i>Qty per Assy</i>	<i>Qty per Leg</i>	<i>Common with Addenda( s)</i>
Drq 31	133-5106	Shoulder Bolt	A	1	16	36	
		Washer Flat M6 Zinc Plated			2	2	
		Screw SHCS M6 x 14 Zinc Plated			2	2	
		Screw SHCS M6 x 30 Zinc Plated			1	1	
Drq 32	133-5107	Roller	A	1	1	1	
Drq 71	133-5521	Washer Cable	A	1	8	16	
Drq 35	133-5110	Cable Assembly Femur	A	1	4	4	
		Hex Lock Nut M5			4	20	
Drq 75	133-5516	End Cover	A	1	1	2	
Drq 83	133-5525	Insert Molded End Cover	A	1	4	8	
		Screw BHCS M6 x 16			6	12	
		Screw BHCS M5 x 8 Zinc Plated			4	8	
		Screw SHCS M3 x 6 Zinc Plated			4	8	
		Screw MFSSP M8 x 16			2	4	
Drq 18	133-5025	Tape Impact Segment	A	1	6	14	
Drq 21	133-5028	Tape End Cover 12 x 24	A	1	1	2	
Drq 20	133-5027	Tape End Cover 10 x 12	A	1	4	8	
Drq 19	133-5026	Tape End Cover 12 x 16	A	1	2	4	
Drq 77	133-5518	Cover End Impact	A	1	1	2	
Drq 78	133-5519	Cover End Impact Knee End	A	1	1	2	
Drq 76	133-5517	Impact Segment	A	1	6	14	
Drq 2	133-5001	Shim T 0.5 optional	A	1	A/R	A/R	
Drq 3	133-5002	Shim Bone Clamp (T 0.05) optional	A	1	A/R	A/R	
Drq 4	133-5003	Shim Bone Clamp (T0.5) optional	A	1	A/R	A/R	
Drq 5	133-5004	Shim Bone Clamp (T 0.6) optional	A	1	A/R	A/R	
Drq 6	133-5005	Shim (T 0.6) optional	A	1	A/R	A/R	
Drq 9	133-5012	Shim 0.05 (optional)	A	1	A/R	A/R	
		Cable Tie 5/8 inch Bundle Dia			2	4	
Drq 22	133-5029	Shim 0.1 Thick (optional)	A	1	A/R	A/R	
Drq 23	133-5030	Shim 0.2 Thick (optional)	A	1	A/R	A/R	
Drq 24	133-5031	Shim 0.4 Thick (optional)	A	1	A/R	A/R	
Drq 39	133-5300	Knee Assembly FlexPLI	A	1	1	1	
Drq 57	133-5330	Knee Block Tibia FlexPLI	A	1	1	1	
Drq 51	133-5312	Insert M1.6 (M3 OD)	A	1	3	3	
Drq 52	133-5313	Meniscus Assembly	A	1	1	1	
Drq 40	133-5301	Meniscus Plate	A	1	1	1	
Drq 42	133-5303	String Guide Knee	A	1	2	2	
Drq 42	133-5307	String Guide AP	A	1	2	2	
Drq 48	133-5309	Cable Guide AP Ligament	A	1	4	4	
		M3 Insert for Plastic x 5.6 long			2	2	
Drq 47	133-5308	Wire Retainer Knee	A	1	2	2	
		Screw FHCS M3 x 6					
Drq 90	61-503-05-01-00	Cable Assy Right String Pot	A	1	2	2	
Drq 91	61-507-05-01-00	Cable Assy Left String Pot	A	1	2	2	
		Screw SHCS M5 x 10 Low Head			4	4	
Drq 56	133-5320	Knee Block Femur	A	1	1	1	
Drq 41	133-5302	Attachment Plate String Pot	A	1	1	1	
		Spring 12 Od x 6 ID x 40 long 71.1 N/mm			8	8	
		Spring 18 OD x 9 ID x 80 long 76.7 N/mm			16	16	
Drq 49	133-5310	Spring Cap	A	1	8	8	
Drq 55	133-5318	Spring Cap Knee Block Tibia	A	1	8	8	
Drq 50	133-5311	Cable Washer	A	1	8	8	
Drq 58	133-5350	Cable Assembly Knee ML	A	1	8	8	
		Screw FHCS M3 x 10			2	2	

<i>ECE/TRANS/WP.29/1 101/Add.3/...<sup>2</sup></i>	<i>Part Number</i>	<i>Description</i>	<i>Drwg Revision</i>	<i>No of Sheets</i>	<i>Qty per Assy</i>	<i>Qty per Leg</i>	<i>Common with Addenda( s)</i>
Drg 54	133-5315	Cover Knee Femur Right Side	A	1	1	1	
Drg 44	133-5306	Cover Knee	A	1	2	2	
Drg 53	133-5314	Cover Knee Tibia Left Side	A	1	1	1	
		Screw FHCS M4 x 8 Zinc Plated			16	16	
Drg 59	133-5360	Cable Assembly Knee AP	A	1	4	4	
		Hex Lock Nut M5			12	20	
		Screw MSSFP M8x30			4	4	
		Screw BHCS M8 x 35 Zinc Plated			4	4	
Drg 15	133-5018	Tape Front cover	A	1	4	4	
Drg 43	133-5304	Cover Upper Knee FlexPLI	A	1	1	1	
Drg 44	133-5305	Cover Lower Knee FlexPLI	A	1	1	1	
Drg 60	133-5500	Tibia Assembly FlexPLI	A	2	1	1	
Drg 87	133-5565	PCB Bone Assembly 4 Channel Tibia	A	2	1	1	
		ID Chip			4	12	
		Resistor 150 Ohm 1/16W 0.1% 0603 SMD			8	16	
		Resistor 200 Ohm 1/16W 0.1% 0603 SMD			8	16	
		Ribbon Cable 20 conductor			A/R	A/R	
		Cable Tie 2-7/8 inch			1	2	
Drg 34	133-5109	Tape Acrylic Foam	A	1	1	2	
Drg 79	133-5520	Tibia Bone	A	1	1	1	
		Connector 16 Pin W/Latch			1	2	
		Connector 7 Pin W/Latch			1	6	
	734-2008	Backshell 16 Pin Circular Connector w/Latch			1	2	
	734-2007	Backshell 7 Pin Circular Connector w/Latch			1	6	
		Strain Gage (350 Ohm)			8	14	
		Cable 16 Conductor			A/R	A/R	
		Cable 7 Conductor			A/R	A/R	
Drg 61	133-5502	Bone Clamp Thick Femur/Tibia	A	1	1	2	
Drg 62	133-5503	Bone Clamp Thin Femur/Tibia	A	1	1	2	
Drg 63	133-5504	Shim Bone Clamp (0.4 Thick) optional	A	1	A/R	A/R	
Drg 64	133-5505	Spacer Bone Contact Thick	B	1	7	12	
Drg 65	133-5506	Bone Clamp Thick Knee	A	1	1	2	
Drg 66	133-5507	Spacer Bone Contact Thin	B	1	7	12	
Drg 67	133-5508	Bone Clamp Thin Knee	A	1	1	2	
Drg 68	133-5509	Shim (0.4 Thick) optional	A	1	A/R	A/R	
Drg 69	133-5510	Rubber Buffer Femur/Tibia End	A	1	1	2	
Drg 70	133-5511	Segment Bottom Tibia	A	1	1	1	
Drg 85	133-5534	Inner Segment Assembly	B	1	7	12	
Drg 71	133-5512	Rubber Buffer	A	1	2	32	
Drg 72	133-5513	Inner Segment	A	1	1	14	
Drg 86	133-5535	Inner Segment Assembly Close to Knee	B	1	1	2	
Drg 71	133-5512	Rubber Buffer	A	1	4	32	
Drg 72	133-5513	Inner Segment	A	1	1	14	
Drg 73	133-5514	Inner Segment Knee	A	1	1	2	
Drg 74	133-5515	Link	A	1	18	32	
Drg 30	133-5104	Washer 12 ID x 26 OD x 3	A	1	4	8	
Drg 31	133-5106	Shoulder Bolt	A	1	20	36	
Drg 80	133-5521	Washer Cable	A	1	8	16	
Drg 84	133-5530	Cable Assembly Tibia	A	1	4	4	
		Screw BHCS M6 x 18 Zinc Plated			32	60	
		Hex Lock Nut M5			4	20	
Drg 75	133-5516	End Cover	A	1	1	2	
Drg 83	133-5525	Insert Molded End Cover	A	1	4	8	
		Screw BHCS M6 x 16			6	12	

<i>ECE/TRANS/WP.29/1 101/Add.3/...<sup>2</sup></i>	<i>Part Number</i>	<i>Description</i>	<i>Drwg Revision</i>	<i>No of Sheets</i>	<i>Qty per Assy</i>	<i>Qty per Leg</i>	<i>Common with Addenda( s)</i>
		Screw BHCS M5x8 Zinc Plated			4	8	
		Screw SHCS M3x6 Zinc Plated			4	8	
		Screw MSSFP M8 x 16			2	4	
Drq 13	133-5025	Tape Impact segment	A	1	8	14	
Drq 21	133-5028	Tape End Cover 12 x 24	A	1	1	2	
Drq 20	133-5027	Tape End Cover 10 x 12	A	1	4	8	
Drq 19	133-5026	Tape End Cover 12 x 16	A	1	2	4	
Drq 78	133-5519	Cover End Impact (Knee End)	A	1	1	2	
Drq 76	133-5517	Impact Segment	A	1	8	14	
Drq 77	133-5518	Cover End Impact	A	1	1	2	
Drq 2	133-5001	Shim T 0.5 optional	A	1	A/R	A/R	
Drq 3	133-5002	Shim Bone Clamp T 0.05 optional	A	1	A/R	A/R	
Drq 4	133-5003	Shim Bone Clamp T 0.5 optional	A	1	A/R	A/R	
Drq 5	133-5004	Shim Bone Clamp T 0.6 optional	A	1	A/R	A/R	
Drq 6	133-5005	Shim T 0.6 optional	A	1	A/R	A/R	
Drq 9	133-5012	Shim T 0.05 (optional)	A	1	A/R	A/R	
Drq 81	133-5522	Wire Exit Base	A	1	2	2	
Drq 82	133-5523	Wire Exit Clamp	A	1	2	2	
		Screw BHCS M5 x 12 Zinc Plated			2	2	
		Cable Tie 5/8" Bundle Diameter			2	4	
Drq 22	133-5029	Shim 0.1 Thick optional	A	1	A/R	A/R	
Drq 23	133-5030	Shim 0.2 Thick optional	A	1	A/R	A/R	
Drq 24	133-5031	Shim 0.4 Thick optional	A	1	A/R	A/R	
Drq 25	133-5034	Catch Rope Bracket	A	1	A/R	A/R	
Drq 36	133-5112	Wire Setting Tool	A	1	1	1	
Drq 37	133-5113	Setting Tool Knee Attachment	A	1	2	2	
Drq 89	61-301-05-01-00	Accel Assembly ASE-A-500	A	1	1	1	
Drq 88	61-201-05-01-00	Accel Assembly 64C-2000	A	1	1	1	
Drq 95	TE 133-8120	Bone and Knee Assy Cal Fixtures	B	2	1		
Drq 98	133-8124	Side Plate Legs	A	1	2		
Drq 99	133-8125	Pivot Base	A	1	2		
Drq 92	133-8031	PTFE Sheet	A	1	2		
		Screw FHCS M8 x 30					
Drq 100	133-8126	Knee Pivot Side Plate	A	1	2		
Drq 101	133-8127	Spacer	A	1	2		
Drq 96	133-8121	Knee Cal Insert Tibia Side	B	1	1		
Drq 97	133-8122	Knee Cal Insert Femur Side	B	1	1		
Drq 94	133-8105	Knee Loading Profile	A	1	1		
Drq 93	133-8102	Leg Loading Spigot	A	1	1		
		Screw, MSSFP M8 x 12			4		
Drq 200	13011401	Repl. Bone Tibia (alternative cable routing)	A	1	1		
Drq 201	13112701	Repl. Bone Femur (alternative cable routing)	A	1	1		
Drq 202	13011402	Repl. FlexPLI Bone Clamp Thick (alternative cable routing)	A	1	2		
Drq 203	13011403	Repl. FlexPLI Bone Clamp Thin (alternative cable routing)	A	1	2		

## 2. FlexPLI User Manual<sup>11</sup>