FlexPLI weight tolerances

Reduction of proposed weight tolerances

International Organization of Motor Vehicle Manufacturers (OICA)

04.12.2013
## Pedestrian Protection

### FlexPLI weight tolerances

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong></td>
<td>Proposal in draft regulative language</td>
</tr>
<tr>
<td></td>
<td>Assessment of proposed assembly tolerances</td>
</tr>
<tr>
<td></td>
<td>Assessment of the weight of available FlexPLI’s</td>
</tr>
<tr>
<td><strong>B</strong></td>
<td>Proposal for reduced FlexPLI assembly tolerances</td>
</tr>
</tbody>
</table>

**Proposal**
Proposal in regulative language

6.3.1.1. **Flexible lower** legform impactor:

The flexible lower legform impactor shall consist of the flesh and skin, the flexible long bone segments (representing the femur and the tibia), and the knee joint as shown in Figure 12.

**The assembled length of the impactor shall be 928 mm, having a total mass of 13.2 ± [0.7 kg].** When fully assembled in the impactor, the measurable lengths of the femur shall be 339 mm, of the knee joint shall be 185 mm and of the tibia shall be 404 mm. The knee joint centre position shall be 94 mm from the top of the knee joint at the vertical centre line of the knee.
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Proposal in regulative language

6.3.1.1.3

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 $9.38 \pm 0.46$ kg.
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FlexPLI weight tolerances

Assessment of proposed assembly tolerances

• Possible maximum weight range of 1.4 kg represents more than 10% of the total weight of the FlexPLI

• Tolerances incorporate different sensor equipment for different FlexPLI’s

• The tolerances of the assembled mass of the femur, the knee joint and the tibia are calculated by summarization of the tolerances of the subassemblies
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Assessment of proposed assembly tolerances

• The FlexPLI shall be standardized in its state of construction for type approval or certification use

• Reduction of possible testing tolerances for reproducibility and comparability of test results
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## FlexPLI weight tolerances

### Assessment of the weight of available FlexPLI’s

<table>
<thead>
<tr>
<th></th>
<th>target weight GTR9</th>
<th>#1</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>mean values</th>
<th>max deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>total weight of neoprene covers (N1F + N1T + N2F + N2T + N3)</td>
<td>0.979</td>
<td>0.970</td>
<td>0.932</td>
<td>1.051</td>
<td>0.967</td>
<td>0.991</td>
<td>0.946</td>
<td>0.980</td>
<td>0.119</td>
<td></td>
</tr>
<tr>
<td>total weight of rubber sheets (R1+R2)</td>
<td>2.780</td>
<td>2.764</td>
<td>2.915</td>
<td>2.8</td>
<td>2.745</td>
<td>2.730</td>
<td>2.833</td>
<td>2.801</td>
<td>0.151</td>
<td></td>
</tr>
</tbody>
</table>
Assessment of the weight of available FlexPLI’s

**Total Mass**

<table>
<thead>
<tr>
<th>FlexPLI</th>
<th>Weight [ kg ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>13,017</td>
</tr>
<tr>
<td>#2</td>
<td>13,027</td>
</tr>
<tr>
<td>#3</td>
<td>13,129</td>
</tr>
<tr>
<td>#4</td>
<td>13,373</td>
</tr>
<tr>
<td>#5</td>
<td>12,998</td>
</tr>
<tr>
<td>#6</td>
<td>13,215</td>
</tr>
<tr>
<td>#7</td>
<td>13,347</td>
</tr>
</tbody>
</table>

- **Lower weight limit**: 12.5 kg
- **Nominal weight**: 13.2 kg
- **Upper weight limit**: 13.9 kg

* tolerance range in actual draft regulative language
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FlexPLI weight tolerances

Assessment of the weight of available FlexPLI’s

Assembled mass of femur, knee joint and the tibia, without flesh and skin

- Lower weight limit: 8.92 kg
- Nominal weight limit: 9.38 kg
- Upper weight limit: 9.84 kg

* tolerance range in actual draft regulative language

* #1
* #2
* #3
* #4
* #5
* #6
* #7

- 0.46 kg *
+ 0.46 kg *
Proposal for reduced FlexPLI weight tolerances

- Weight tolerance of ± 0.35 kg for total FlexPLI
- Weight tolerance of ± 0.23 kg for assembled mass of femur, the knee joint and the tibia without the flesh and skin
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FlexPLI weight tolerances

Proposal for reduced FlexPLI weight tolerances

- Unchanged tolerances for femur, tibia and knee subassemblies (position of center of gravity of FlexPLI)

Figure 12 of doc.
UNECE/TRANS/WP.29/GRSP/2013/25
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FlexPLI weight tolerances

Proposal for reduced FlexPLI weight tolerances

Total Mass

Lower Flex PLI weight limit
12.85 kg

Nominal Flex PLI weight
13.2 kg

Upper Flex PLI weight limit
13.55 kg

- 0.35 kg *

#1
13,017
12,600
12,700
12,800
12,900
13,000
13,100
13,200
13,300
13,400
13,500
13,600
13,700
13,800
13,900
14,000

* tolerance range in actual draft regulative language

Weight [ kg ]
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## FlexPLI weight tolerances

### Proposal for reduced FlexPLI weight tolerances

Assembled mass of femur, knee joint and the tibia, without flesh and skin

<table>
<thead>
<tr>
<th>FlexPLI</th>
<th>Lower weight limit</th>
<th>Nominal weight limit</th>
<th>Upper weight limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>9.207 kg</td>
<td>9.522 kg</td>
<td>9.61 kg</td>
</tr>
<tr>
<td>#2</td>
<td>9.242 kg</td>
<td>9.522 kg</td>
<td></td>
</tr>
<tr>
<td>#3</td>
<td>9.219 kg</td>
<td>9.445 kg</td>
<td></td>
</tr>
<tr>
<td>#4</td>
<td>9.24 kg</td>
<td>9.522 kg</td>
<td></td>
</tr>
<tr>
<td>#5</td>
<td>9.15 kg</td>
<td>9.38 kg</td>
<td></td>
</tr>
<tr>
<td>#6</td>
<td>9.207 kg</td>
<td>9.522 kg</td>
<td></td>
</tr>
<tr>
<td>#7</td>
<td>9.23 kg</td>
<td>9.522 kg</td>
<td></td>
</tr>
</tbody>
</table>

Lower weight limit 9.15 kg
Nominal weight limit 9.38 kg
Upper weight limit 9.61 kg

-0.23 kg to +0.23 kg
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FlexPLI weight tolerances

Thank you for your attention!

On behalf of OICA, provided by:
Winfried Schmitt, BMW
Thomas Kinsky, OPEL
Jörg Kusche, PORSCHE
Klaus Rathje, DAIMLER
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BACK-UP
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FlexPLI weight tolerances

Figure 15
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FlexPLI weight tolerances

FlexPLI version GTR User Manual (document GTR9-6-06):

**2.1 Standard 12 Channel Instrumentation**

FlexPLI GTR is offered with 12 channel standard instrumentation, measuring tibia and femur bending moments and knee ligament elongations as well as tibia acceleration in impact direction. The standard instrumentation channels are listed in Table 2. The channels intended for injury assessment are the 4 tibia bending moments, knee medial collateral ligament (MCL) elongation and ACL and PCL elongations are being monitored. These channels are controlled by the certification procedures given in Sections 6 and 8.

<table>
<thead>
<tr>
<th>Instrument Channels</th>
<th>Purpose</th>
<th>Standard</th>
<th>DAS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Femur moment 1,2 and 3</td>
<td>-</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Tibia moment 1,2,3 and 4</td>
<td>Injury Assessment</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Tibia Top Acceleration AX</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MCL elongation</td>
<td>Injury Assessment</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>ACL elongation</td>
<td>Monitoring</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>PCL elongation</td>
<td>Monitoring</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>LCL elongation</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. 12 Channel Instrumentation

Number of sensors can be increased depending on the usage of the impactor (User Manual lists up to 30 additional sensors as optional equipment)