General Information for the Flexible Pedestrian Legform Impactor - type G - (Flex-G)

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BACKGROUND

• In 2004, we developed a Flexible Pedestrian Legform Impactor ver. 2004 (Flex-PLI 2004) and loaned the Impactor to several organizations (NHTSA, JAMA member, J-MLIT).
• After the loan activities, we obtained several comments for the impactor improvement.
• In 2005, we developed a Flex-G which is developed to improve several parts of the Flex-PLI 2004.
• This presentation introduce the Flex-G specifications.
Structure
Basic structure

Basic structure is same
# Specifications

## Length, C.G. location, and Mass

<table>
<thead>
<tr>
<th>Length, C.G. location, and Mass</th>
<th>50th percentile of American Male*</th>
<th>Flex-G</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Thigh length (mm)</td>
<td>428</td>
<td>433</td>
</tr>
<tr>
<td>b) Leg length (mm)</td>
<td>493</td>
<td>495</td>
</tr>
<tr>
<td>c) C.G. location of thigh (mm) **</td>
<td>218</td>
<td>213</td>
</tr>
<tr>
<td>d) C.G. location of leg (mm) **</td>
<td>233</td>
<td>225</td>
</tr>
<tr>
<td>e) Total leg form impactor mass (kg)</td>
<td>13.4</td>
<td>13.9</td>
</tr>
<tr>
<td>f) Thigh mass (kg)</td>
<td>8.6</td>
<td>8.6</td>
</tr>
<tr>
<td>g) Leg mass (kg)</td>
<td>4.8</td>
<td>5.3</td>
</tr>
</tbody>
</table>


** from the knee joint center

Comparable to the 50th percentile of American Male
Long bones
outer shape

Flex-PLI 2004

slightly different shape

Flex-G
Long bones
outer shape (cont.)

Flex-G

Oblique view  Frontal view  Side view  Back view
Long bones
outer shape (cont.)

Reason: To install bending stopper cables into the long bone parts (prevents to apply large bending onto the long bone parts)

Initial -> Free for bending (does not generate any tensions)
After a certain bending level -> Work to prevent bending

make 4mm space for tension free (photo is before setting)

hole for bending stopper cables
bending stopper cables
**Long bones**

**screw setting**

- Flex-PLI 2004

Reason: Easy maintenance (need not to check the screw torque after each test)

- Flex-G

**torque control**

- just tight enough
- just putting a spacer
- just keeping position of spacers

**bone core**

**binding force**
Long bones
cross-sectional shape of bone core

Flex-PLI 2004

Thigh

Leg

Reason: To improve durability of long bones

Flex-G

Thigh

Leg

unit mm
Long bones
biofidelity of thigh

**Flex-PLI 2004**

- Support length: 360 mm

**Flex-G**

- Support length: 400 mm

Test Type: Thigh-400M-R25-P

Moment is calculated by support forces and support length.

Support length (PMHS test: 404.1 mm)

More appropriate support length
Long bones
biofidelity of leg

**Flex-PLI 2004**
support length: 320 mm

**Flex-G**
support length: 330 mm

More appropriate support length (PMHS test: 334.4 mm)
Knee joint
surface of condyle

**Flex-PLI 2004**

- **Material**: Steel
- **Reason**: Easy maintenance (easy to set initial position)
- **Frontal view**: no groove
- **Side-frontal view**: no groove

**Flex-G**

- **Material**: Plastic
- **Reason**: To decrease the friction force at the contact surface
- **Frontal view**: Groove
- **Side view**: Groove

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Knee joint

knee spring

Flex-PLI 2004

Reason: To close its bending stiffness to the PMHS one

Flex-G (SN: 1)
Knee joint biofidelity

Flex-PLI 2004

Much closer to the PMHS response corridor

Flex-G

Test Type: Knee-3PB-396-R50
* Moment is calculated by support force and support length.

Inertia effect

bottoming
Flesh
number of sheets

Flex-PLI 2004

Flex-G

Propel

Neoprene

Rubber
Flesh
number of sheets (cont.)

Flex-G

Neoprene

Rubber

Side view
Frontal view

Reason: To obtain comparable thigh and leg response of the PMHS ones.
Measurement
Long bones
measurement items and positions

Flex-PLI
2004

Flex-G

Measurement items and positions are same
Long bones
strain gage cables

1) shield cable

2) outer cover

Reasons:
1) for better measurement
2) to increase durability of cables

Flex-PLI 2004

W = 3.4 mm (t = 1.1 mm)

W = 3.4 mm (t = 1.1 mm)

Flex-G
Certification test
Assembly Dynamic Certification Test (initial setting)
Assembly Dynamic Certification Test (test method)

- Leg suspension angle 15 deg.
- Free fall without Flesh rubber (5mm x1) neoprene (5mm x1)
- Put neoprene and rubber sheet onto the impact face
- Knee joint surface level
- Angular measurement
- Pin Joint

without Flesh
Assembly Dynamic Certification Test (impact face)

rubber (5mm x1)

neoprene (5mm x1)
Assembly Dynamic Certification Test (example at BASt/BGS)

(1) set 15 deg.

(2) release
Assembly Dynamic Certification Test Procedure
(example at BAST/BGS)

Step 1) set zero level for sensors

Step 2) attach rubber and neoprene at the impact face

Step 3) set the impactor to the 15 degree upward from horizontal level and release
Test flow 1
- Assembly Dynamic Calibration Test
  around 20 min.
- Test

Test flow 2
- r = output / threshold
  (r>1) (r≤1)
  around 20 min.
- Assembly Dynamic Calibration Test

Test flow 3
- Visible Checking only
  around 10 min.
- Test

*photo is for Flex-PLI 2004

Test flow 1 or 2 is recommendable
Car test
Size: W=60 mm or over, t= 20 mm,  
L= 300 mm or over (for leg), 240 mm or over (for thigh)  
Surface condition: Flat  
Material: Relatively hard materials are needed.  
(e.g. hard rubber, aluminum, etc).  
*Please contact to JARI more details. 

Attach the spacers at the center of the second bone core segments.
CONCLUSIONS

• Flex-G is developed with several modifications onto the Flex-PLI 2004.
• We are very appreciate to evaluate the Flex-G by many organizations/users, and to obtain precious comments for the Flex-G improvement.
Thank you for your attention.