Lower Legform Test Area

Justification of the Need for a Relaxation Zone

International Organization of Motor Vehicle Manufacturers (OICA)
# Pedestrian Protection

## Lower Legform Relaxation Zone

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Introduction

• The proposed draft amendment to gtr9 contains language with increased thresholds for tibia moments for a maximum aggregated width of 264 mm:

In addition, the manufacturer may nominate bumper test widths up to a maximum of 264 mm in total where the absolute value of the tibia bending moment 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.
Original concept of a relaxation zone

• The concept of a relaxation zone was taken over from the existing gtr9 language where it was originally defined for the testing with the EEVC legform.

• A zone of relaxed requirements was proposed by industry for feasibility reasons but also by TRL in their study on behalf of the European Commission (see document PS-89 of the UNECE Informal Group on Pedestrian Safety, p. 106):

  □ Allow manufacturers to nominate bumper test widths of up to 264 mm in total, for testing with an acceleration protection requirement of 250 g. *(This will provide a more controlled relaxation than currently allowed in phase one where derogation (no test) is allowed for a removable towing hook. Again it is not proposed that the bending angle or knee shear be increased in a similar way for the reason set out above. It is thought more reasonable not to link this relaxation to specific features such as towing eyes so that it can be used for any difficult area.)*

  All of the above changes for feasibility are strongly recommended.
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Original concept of a relaxation zone

- Concept was maintained in the updated version of TRL’s study on behalf of the European Commission (see document PS-120 of the UNECE Informal Group on Pedestrian Safety, p. 22):

<table>
<thead>
<tr>
<th>Test tool and parameter</th>
<th>Acceptance criterion / injury risk</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current phase two</td>
</tr>
<tr>
<td>Lower legform, knee bending angle</td>
<td>15° / 5.4%</td>
</tr>
<tr>
<td>Lower legform, tibia acceleration</td>
<td>150 g / 9.0%</td>
</tr>
<tr>
<td>Upper legform, sum of forces</td>
<td>5 kN / 10.3%</td>
</tr>
<tr>
<td>Upper legform, bending moment</td>
<td>300 Nm / 11.8%</td>
</tr>
<tr>
<td>Headform, HIC</td>
<td>1000 / 7.0%</td>
</tr>
</tbody>
</table>
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Original concept of a relaxation zone

- TRL acknowledges repeatedly in their studies that car manufactures have to apply a compliance margin of 20 % to 25 % in their design for vehicle type approval testing and conformity of production (e.g. section 7.2.5 Approval and conformity of production, p. 91f. of PS-89)
In order for the vehicle to provide adequate occupant protection in frontal crashes, portions of the vehicle bumper structure will have to be stiff enough to enable the vehicle to absorb a sufficient amount of the impact energy. In addition, the bumper structure contains towing hooks and other devices. Because of these factors, certain portions of the bumper will not be able to meet the maximum lateral tibia acceleration limit of 170g across the full length of the bumper. For feasibility reasons, this GTR allows manufacturers to nominate bumper test widths up to 264 mm in total where the acceleration measured at the upper end of the tibia shall not exceed 250 g. The relaxation zone of 264 mm corresponds to an area that is twice the width of the legform.
Constitution of a relaxation zone in gtr9

B. TEXT OF THE REGULATION
5. Performance requirements
5.1. Legform to bumper

5.1.1. When tested in accordance with paragraph 7.1.1. (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 170g. In addition, the manufacturer may nominate bumper test widths up to a maximum of 264 mm in total where the acceleration measured at the upper end of the tibia shall not exceed 250g.
Discussion in the FlexPLI Technical Evaluation Group

• The former FlexPLI Technical Evaluation Group noted that a relaxation zone was granted for the EEVC legform impactor but had difficulties to come to a final conclusion on that for the FlexPLI

• However, it must be noted that, as a result of the discussion in the TEG, the proposed relaxed values were already significantly reduced from nearly 50 % allowed increase for the EEVC LFI to less than 15 % for the FlexPLI, considering potential issues with the durability of the bone core material, and apply only to the tibia bending moments

• Finally, manufacturers need to ensure conformity of production for their vehicles. When considering a usual safety margin of 20 %, in fact the design targets are 304 Nm and therefore are always below the impactor threshold of 340 Nm.
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Examples of design premises in current vehicle design

- Bumper UNECE R 42
- Bumper Part 581
- NCAP requirement EEVC legform
- NCAP requirement FlexPLI
- Frontal impact UNECE R 94
- Employers Liability Insurance Association BGV D29
- Towing hook Recovery hook R(EU) 1005/2010

Legislation EEVC legform
Legislation FlexPLI
Headlamp washer system UNECE R 45

IG GTR9 – Phase 2, 9th meeting, Geneva
Examples of technical characteristics potentially causing higher tibia loads

- Sensor systems (e.g. cameras, sensors, radar, ...) especially for more demanding future systems for VRU*) protection and collision mitigation AEBS**
- Towing hook (recovery hook)
- Headlamp washer system
- Footsteps for commercially used vehicles
- Respective systems are already in use and relaxation zones are applied today

*) VRU Vulnerable Road Users
**) AEBS Autonomous Emergency Braking Systems
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Justification of the need for a relaxation zone in the amended gtr9

Summary:

- Conflicting lower leg regulative requirements, worldwide
- Different worldwide NCAP requirements
- Additional passive safety bumper requirements
- Other requirements on bumper design beyond passive safety
- Vehicles which have to comply to these combined requirements will have their market launch in future

Consequently, the current concept of a relaxation zone should be maintained, the square brackets covering this subject in the current draft gtr No. 9 Phase 2 should be removed
Thank you for your attention!

On behalf of OICA, provided by:

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