GTR9-9-04r1

Lower Legform Test Area

Justification of the Need for a Relaxation Zone

International Organization of Motor Vehicle Manufacturers (OICA)

04.12.2013

Pedestrian Protection

Lower Legform Relaxation Zone

A	Introduction
	Original concept of a relaxation zone
	Relaxation zone in the current gtr9
	Discussion in the FlexPLI Technical Evaluation Group
B Proposal	Examples of design premises for current vehicle design
	Examples of technical characteristics causing higher tibia loads
	Justification of the need for a relaxation zone in the amended gtr9

Pedestrian Protection

Lower Legform Relaxation Zone

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.

Pedestrian Protection

Lower Legform Relaxation Zone

Original concept of a relaxation zone

- The concept of a relaxation zone was taken over from the existing gtr9 language were 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.

Pedestrian Protection

Lower Legform Relaxation Zone

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 4.1. Injury causing parameters, acceptance criteria proposed and injury risks used in the analysis based on manufacturer's targets at 80 percent of the acceptance criteria

Test tool and parameter	Acceptance criterion / injury risk				
	Current phase two	TRL proposal: main area	TRL proposal: relaxation area	ACEA 12/04 proposal: main area	ACEA 12/04 proposal: relaxation area
Lower legform, knee bending angle	15° / 5.4%	19° / 10.2%	19° / 10.2%	19° / 10.2%	19° / 10.2%
Lower legform, tibia acceleration	150 g / 9.0%	190 g / 18.9%	250 g / 48.3%	170 g / 13.1%	250 g / 48.3%
Upper legform, sum of forces	5 kN / 10.3%	6.25 kN / 20.2%	7.5 kN / 36.8%	not tested	not tested
Upper legform, bending moment	300 Nm / 11.8%	375 Nm / 18.3%	510 Nm / 40.3%		
Headform, HIC	1000 / 7.0%	1250 / 15.5%	2000 / 63.8%	1000 / 7.0%	1700 / 42.3%

Pedestrian Protection

Lower Legform Relaxation Zone

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)

Pedestrian Protection

Lower Legform Relaxation Zone

Justification of a relaxation zone in gtr9 preamble

Part A - STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION

7. PEDESTRIAN LEG PROTECTION

(b) Lower legform test

(iii) Relaxation of acceleration limit

115. 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.

GTR9-9-04r1

Pedestrian Protection

Lower Legform Relaxation Zone

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.**

Pedestrian Protection

Lower Legform Relaxation Zone

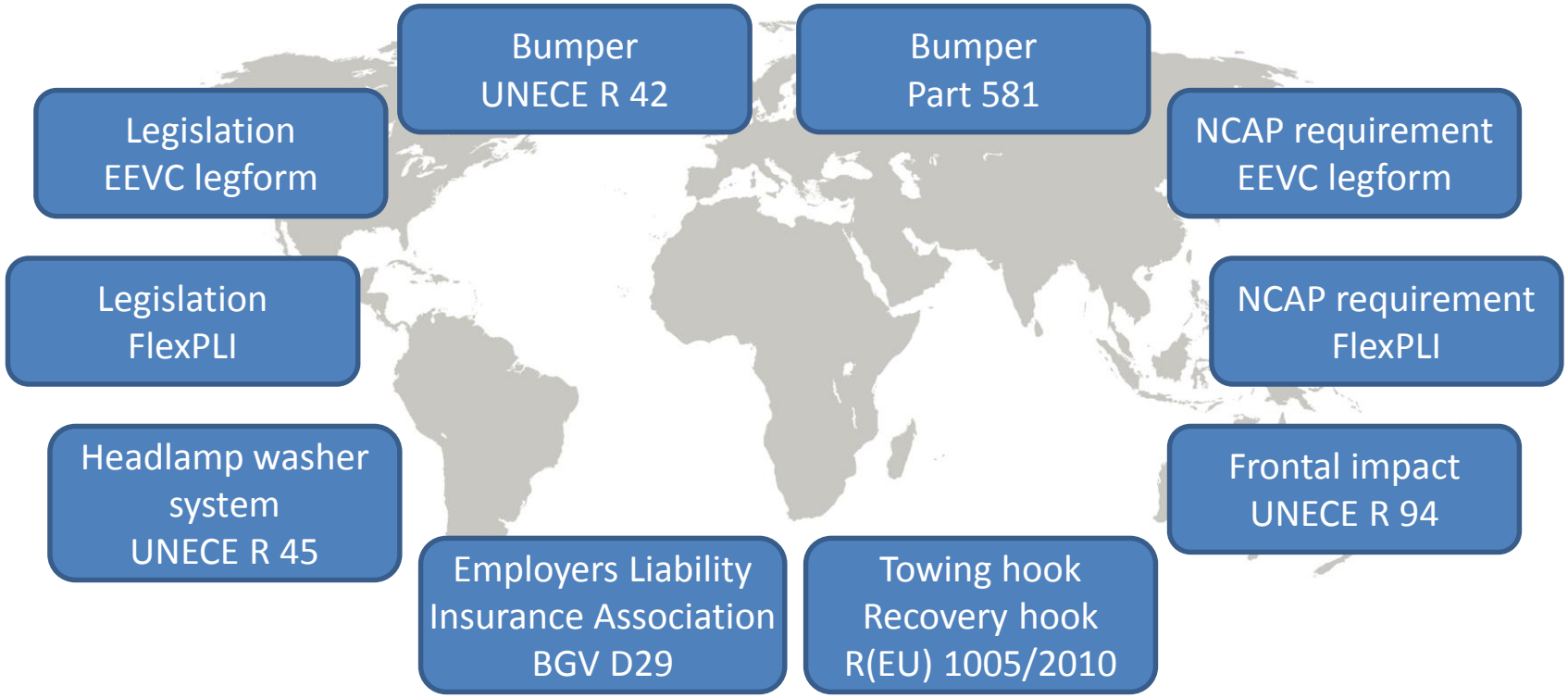
Discussion in the FlexPLI Technical Evaluation Group

- 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.

Pedestrian Protection

Lower Legform Relaxation Zone

Examples of design premises in current vehicle design



Pedestrian Protection

Lower Legform Relaxation Zone

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

GTR9-9-04r1

Pedestrian Protection

Lower Legform Relaxation Zone

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

Pedestrian Protection

Lower Legform Relaxation Zone

Thank you for your attention!

On behalf of OICA, provided by:

Winfried Schmitt, BMW
Jan Wilsmann, BMW
Thomas Kinsky, OPEL
Raimondo Sferco, FORD