TF-DPPS/2/06

Submitted by the expert from Republic of Korea and OICA

Informal document **GRSP-58-31**_OICA (58th GRSP, 8-11 December 2015, agenda item 4)

Proposal for the amendments to Global Technical Regulation No. 9 (Pedestrian Protection)

Incl. modifications proposed by pedestrian safety experts of OICA_rev.;
Incl. items discussed in the 1st meeting of TF-DPPS (for reference only!)
Incl. items proposed by Japan

This informal document is prepared by Republic of Korea and OICA based on a paper that (INF/GR/PS/141 Rev.1) of the former IWG available at:
www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/pedestrian_8.html
The modifications to the current text of the Regulation are marked in bold or strikethrough characters.

A. Proposal

Amend paragraph 3.1., to read:

"3.1. 'Adult headform test area' is an area on the outer surfaces of the front structure. The area is bounded, in the front, by a wrap around distance (WAD) of 1,700 mm and, at the rear, by the rear reference line for adult headform and, at each side, by the side reference line. **In case of deployable systems, the determination of that area is conducted in the ~~[un]~~deployed position of the outer surface [as defined in paragraphs 3.19. or] 3.~~3~~132. respectively.**
In case of a technology that makes it impossible to maintain its~~mark up in~~ deployed position, the mark-up is conducted in undeployed position."

Insert the new paragraph 3.3., to read:

"**3.3.** '**Appropriate simulation tool' means a numerical or physical tool designed to represent human bodies in the percentiles referred to in Annex 1.**"

Kommentiert [TK1]: Comment BASt: How to validate simulation tools?

Renumber the following paragraphs 3.3. (old) to 3.4. (new), 3.4. (old) to 3.5. (new) etc.

Amend paragraph 3.12. (old), to read:

"3.13. 'Child headform test area' is an area on the outer surfaces of the front structure. The area is bounded, in the front, by the front reference line for child headform, and, at the rear, by the WAD1700 line, and**, at each side,** by the side reference lines. **In case of deployable systems, the determination of that area is conducted in the ~~[un]~~deployed position of the outer surface as defined in paragraphs 3.19. or 3.~~3~~132. respectively. In case of a technology that makes it impossible to maintain its~~mark up in~~ deployed position, the mark-up is conducted in undeployed position."**

Insert the new paragraph 3.14., to read:

"**3.14.** **'Contact sensors' are sensors that detect a pedestrian contact with the front bumper. These sensors include, but are not limited to, accelerometers, fibre optic sensors, pressure sensors, etc.~~,~~**"

Renumber paragraph 3.13. (old) to 3.15. (new).

Insert the following new paragraphs, to read:

"**3.16.** **'Deployable system' means a technical system consisting of the deploying system as defined in paragraph 3.17. and [all] other vehicle components [~~or systems~~involved in the activation], such as the bonnet[, the wiring, the sensors] etc.**

3.17. **'Deploying system' means a technical system, such as e.g. airbags, springs, pyrotechnic actuators etc.~~,~~ that ~~lifts~~ changes the vehicle outer surface as defined in paragraph 3.~~31~~32. from a position of normal use in the vehicle to the deployed position as defined in paragraph 3.19.**

3.18. **'Deployment Time' (DT) is the time from the initiation of a deploying system until the system reaches the deployed position as defined in paragraph 3.19.**

3.19. **'Deployed position' means the position of the vehicle outer surface equipped with the deployable system capable of maintaining the position activated. Deployed position shall be specified by the manufacturer.~~the lifted vehicle outer surface specified by the manufacturer. The lifted vehicle outer surface shall reach a position equal to or above the deployed position during the time between the Total Response Time and the Head Impact Time that corresponds to the rear end of the test area.~~**"

Kommentiert [TK2]: Proposal of the chair to discuss the deletion since this may not be needed for the test procedure when the TRT is defined.

Kommentiert [TK3]: Discussion in TF-DPPS: Since this is a requirement it should move to section 6, shouldn't it?

Renumber the following paragraphs 3.14. (old) to 3.20. (new), 3.15. (old) to 3.21. (new) etc.

Insert the new paragraph 3.24., to read:

"**3.24.** **'Head Impact Time (HIT)' means the time from the first contact of a pedestrian ~~leg~~ with the bumper to the time of a pedestrian head to the outer surface contact.**"

Renumber the following paragraphs 3.18. (old) to 3.25. (new) and 3.19. (old) to 3.26. (new)

Insert new paragraph 3.27., to read:

"**3.27.** **'Initiation of the deploying system' means, by discretion of the manufacturer, either the time when visible movement of the actuator is initially detected or the switching point of the triggering signal sent from the electronic control unit to the deploying system.**"

Renumber the following paragraphs 3.20. (old) to 3.28. (new) and 3.21. (old) to 3.29. (new)

Insert new paragraph 3.30., to read:

"**3.30.** **Non-contact sensors are all sensors other than the contact sensors defined in paragraph 3.14.**"

Renumber the following paragraphs 3.22. (old) to 3.31. (new).

Insert new paragraph 3.32., to read:

"**3.32.** **'Outer surface' means those components of the vehicle within the test areas, which are contacted by the pedestrian in case of an accident. The outer surface may include the bonnet, the fenders, but also external airbags or other components within the test area.**"

Renumber the following paragraphs 3.23. (old) to 3.33. (new).

Insert new paragraph 3.34., to read:

"**3.34.** **'Sensor Time (ST)' is the time:**

From the first contact of a pedestrian with the bumper to the initiation of the deploying system for contact sensors;

From the recognition of an imminent pedestrian impact to the initiation of the deploying system for non-contact sensors."

Renumber the following paragraphs 3.24. (old) to 3.35. (new), 3.25. (old) to 3.36. (new) etc.

Insert new paragraph 3.38., to read:

"**3.38.** **'Total Response Time (TRT)' is the time from the first contact of a pedestrian with the bumper until the system reaches the deployed position as defined in paragraph 3.19.**

Renumber the following paragraphs 3.27. (old) to 3.39. (new), 3.28. (old) to 3.40. (new) etc.

Amend Paragraph 6.2.2., to read:

"**6.2.2.** **Deployable systems designed to protect pedestrians shall be tested according to the test procedure defined in Annex 1. ~~All devices designed to protect vulnerable road users when impacted by the vehicle shall be correctly activated before and/or be active during the relevant test. It shall be the responsibility of the manufacturer to show that any devices will act as intended in a pedestrian impact.~~**"

Insert a new Annex 1., to read:

"**Annex 1.**

TEST PROCEDURE FOR DEPLOYABLE SYSTEMS OF THE OUTER SURFACE

On discretion of the manufacturer, the performance of a deployable system can be shown by, the static headform test procedure or the dynamic headform test procedure as applicable.

In order for systems to be assessed in the deployed position or for the system to be deployed during the tests, it will be necessary for the vehicle manufacturer to provide the relevant detailed information highlighted in this Annex before any testing begins. The vehicle manufacturer is responsible for providing all necessary information regarding detection of pedestrians and the deployment of the system. Based on the evidence provided, activation of the systembonnet position in the headform test will be determineddecided.

1. Requirement of Deployed Position

The vehicle outer surface with the deployable system capable of maintaining the position activated shall reach a position equal to or above the deployed position during the time between the Total Response Time and the Head Impact Time that corresponds to the rear end of the test area.

2. Activation Test to Certify Sensing Area

2.1. A vehicle manufacturer shall specify the area intended to detect a pedestrian.

2.2 The system activation shall be confirmed by using the legform or upper legform impactor at the vehicle speed as specified in this regulation and at the outer most location of the specified area.

2.3 The deployable system may be activated in the headform test only for the area corresponding to the intended area.

3. Test at the Lowest Speed of Activation

3.1 A vehicle manufacturer shall specify the lowest speed of activation of the deployable system.

3.2 The vehicle manufacturer shall provide the evidence showing that the headform test area with the deployable system activated meets the requirements as specified in this regulation at the lowest speed of activation of the deployable system in un-deployed position.

3.3 All the headform tests shall be conducted in un-deployed position if the manufacturer does not show enough evidences.

14. Determination of ~~Static~~ Headform Test Procedure

The static verification of the deployable system is based on the comparison of the TRT as defined in paragraph 3.38. with the HIT as defined in paragraph 3.24. To conduct static headform tests in the deployed position, the HIT must be greater than or equal to the TRT.

~~The static headform test procedure is applicable for those areas within the headform test area and for those pedestrian statures where the deployable system is activated as proven by the manufacturer.~~

For the systems which cannot maintain its deployed position, Dynamic Headform Test Procedure as defined in paragraph 3. of this Annex shall apply.

The following steps are conducted:

14.1. The HIT for the relevant pedestrian statures is calculated in the deploy position of the outer surface. Relevant are those statures amongst the 6-year old child, the 5%ile female, the 50%ile male and the 95%ile male, [whose heads] ~~that~~ contact the outer surface in the headform test areas. Pedestrian statures shall be in an appropriate walking posture ~~as defined in paragraph 4.2. of this Annex,~~ using an appropriate simulation tool.
The HIT is calculated at the vehicle speed as specified for the legform impact in this regulation and at the centerline of the vehicle.

14.2. During the step defined in paragraph 14.1. of this Annex, also the Wrap Around Distance (WAD) is determined for the position of the head contact for each pedestrian stature. A graph shall be plotted with a best-fit straight line with respect to each HIT and WAD. This graph shall be used to determine the equivalent HIT for each measuring point with a corresponding WAD.

14.3. The TRT is calculated from the ST as defined in paragraph 3.34. and the DT as defined in item 3.18.:

Total Response Time (TRT) = Sensor Time (ST) + Deployment Time (DT)

A manufacturer may choose to not define ST and DT separately but show the TRT only. In this case, the TRT is measured during a legform to bumper test or during an upper legform to bumper test as appropriate for the location which represents the sensing performance of the system~~vehicle [center line]~~ to be tested, at the vehicle speed as specified in this regulation and at the representative location~~centreline~~ of the vehicle. Test may be omitted in case the representative location is the outer most of the intended area to activate. Alternatively, a manufacturer may omit the determination of the TRT and may select only the dynamic headform test procedure as defined in section 62 of this annex.

14.4. The ST is determined according to section 37 of this Annex.

~~14~~.5. **The DT shall be documented by a travel vs. time diagram from measurement at reference points on the deploying system.**

~~14~~.6. **For the assessment of the deployable system, the TRT is compared with the HIT value as determined in paragraph ~~41~~.2. of this Annex to demonstrate the performance of the system. Headform tests shall be conducted based on the result of the comparison between the TRT and the HIT:**

~~14~~.6.1. **If the TRT is equal to or less than the HIT, perform a static headform test~~s~~ described in section 5 of this Annex with the system in the deployed position as defined in paragraph 3.19. of this regulation. ~~The bonnet shall be set to that position by appropriate means.~~**

~~14~~.6.2. **If the TRT is greater than the HIT, perform a dynamic headform test for all measuring points according to the WAD, following the procedure described in section ~~26~~ of this Annex.**

4.6.3. **If the HIT is less than the ST, perform a headform test in the un-deployed position.**

5. **Static Headform Test Procedure**

5.1. **The outer surface of the vehicle shall represent the deployed position. The outer surface of the vehicle shall be set to that position by appropriate means.**

5.2. **The test procedures specified in sections 7.2. to 7.4. shall apply.**

~~6~~2. **Dynamic Headform Test Procedure**

The dynamic verification of a deployable system is based on a headform test performed on the deployable system, which is deployed synchronized during testing, representing a full human body impact simulation.

~~The procedure is applicable for those areas and pedestrian statures within the headform test area where the deployable system is activated as defined by the manufacturer.~~

The following steps are conducted:

~~6~~2.1. **The HIT for the relevant pedestrian statures is calculated in the undeployed position of the outer surface. Relevant are those statures amongst the 6-year old child, the 5%ile female, the 50%ile male and the 95%ile male, whose heads contact the outer surface in the headform test areas. Pedestrian statures shall be in an appropriate walking posture ~~as defined in 4.2. of this Annex,~~ using an appropriate simulation tool.**
The HIT is calculated at the vehicle speed as specified for the legform impact in this regulation and at the centerline of the vehicle.

~~6~~2.2. **During the step defined in paragraph ~~26~~.1. of this Annex, also the Wrap Around Distance (WAD) is determined for the position of the head contact for each pedestrian stature. A graph shall be plotted with a best-fit straight line with respect to each HIT and WAD. This graph shall be used to determine the equivalent HIT for each measuring point with a corresponding WAD.**

~~2~~6.3. **The ST is determined according to section ~~7~~3 of this Annex.**

~~2~~6.4. **Perform headform tests to the applicable headform test area. The headform propulsion device and the deploying system are synchronized, based on HIT and ST data for each impact, to ensure a test timing representing a full human body impact simulation.**

6.5. **The test procedures specified in sections 7.2. to 7.4. shall apply.**

6.6. **The tolerance shall be determined at the discretion of Technical Service in case the deviation from measuring points cannot be measured using existing appropriate technologies.**

~~3~~7. **Test Procedure to Measure the Sensor Time (ST)**

~~3~~7.1 **For contact sensors as defined in paragraph 3.14. of this regulation, the ST is measured during a legform to bumper test or during an upper legform to bumper test as appropriate for the location which represents the sensing performance of the system~~vehicle~~ to be tested, at the vehicle speed as specified in this regulation and at the representative location~~centreline~~ of the vehicle.**
If the deploying system does not deploy in this test, the headform tests are performed with the deploying system in undeployed position.

~~3~~7.2. **For non-contact sensors as defined in paragraph 3.30. of this regulation, the manufacturer may define the ST based on the technology used.**

~~4~~8. **Simulation model**

~~4~~8.1. **When the numerical or physical simulation is conducted, the manufacturer shall provide enough ~~supporting~~ evidences showing the biofidelity and appropriateness of the posture of the simulation tool as defined in section 3.3. of this regulation ~~as well as the suitable biofidelity and kinematics of the chosen model. The walking posture of the model shall include the following conditions:~~**

~~**4.2.** **The walking pedestrian model shall be facing in a direction perpendicular to the vehicle centerline with the H-point in the same longitudinal plane as the vehicle centerline. The legs must be apart from the default standing posture of the model with the rearward leg being first impacted by the bumper. The heel-to-heel distances shall be as follows, including tolerances of ± 10 mm to account for the different simulation models that can be validated in slightly different positions of the values stated below:**~~

~~**6yo-child: 190 mm**~~

~~**5%-female: 245 mm**~~

~~**50%-male: 310 mm**~~

~~**95%-male: 337 mm**~~

~~4.3. In case of the numerical simulation, the friction value to be applied between the foot and the ground shall be 0.3.~~"

B. Justification

1. Since the current test procedure of GTR No. 9 for deployable devices is not clearly specified and suitable for a self-certification system, the test procedure for deployable devices to protect vulnerable road users should be specific so the test can be consistently carried out.