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## Economic Commission for Europe

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World Forum for Harmonization of Vehicle Regulations

Working Party on Automated/Autonomous and Connected Vehicles

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Item 7 of the provisional agenda

**Advanced Emergency Braking System**

### **Proposal for a supplement to the original text of UN Regulation No. 152 (Advanced Emergency Braking System for M<sub>1</sub> and N<sub>1</sub> vehicles)**

**Submitted by the expert from the European Commission\***

The text reproduced below was prepared by the expert from European Commission. This proposal aims to align the requirements of UN Regulation No. 152 on the relevant last amendments of UN Regulation No. 131. It is based on informal documents GRVA-13-08 and GRVA-13-30. The modifications to the existing text of UN Regulation No. 152 are marked in bold for new characters and strikethrough for deleted characters.

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\* In accordance with the programme of work of the Inland Transport Committee for 2022 as outlined in proposed programme budget for 2022 (A/76/6 (Sect.20), para 20.76), the World Forum will develop, harmonize and update UN Regulations in order to enhance the performance of vehicles. The present document is submitted in conformity with that mandate.



## I. Proposal

Paragraph 1., amend to read (addition of an asterisk):

### 1. Scope

This Regulation applies to the approval of vehicles of Category M<sub>1</sub> and N<sub>1</sub><sup>1</sup>\* with regard to an on-board system to

- (a) Avoid or mitigate the severity of a rear-end in lane collision with a passenger car,
- (b) Avoid or mitigate the severity of an impact with a pedestrian.

**\* This Regulation also offers an alternative set of requirements for vehicles of Category M<sub>2</sub>, and for those of Categories M<sub>3</sub>/N<sub>2</sub> with a maximum weight below or equal to 8 tons, equipped with hydraulic braking, to those contained in UN Regulation No. 131.**

**For the vehicles described above, Contracting Parties that apply both UN Regulation No. 131 and this Regulation recognise approvals to either regulation as equally valid.”**

Paragraph 2.13., amend to read:

“2.13. “Sufficient nominal Peak Braking Coefficient (PBC)”: means a road surface friction coefficient of:

- (a) 0.9, when measured using the American Society for Testing and Materials (ASTM) of E1136-19 standard reference test tyre in accordance with ASTM Method E1337-19 at a speed of 40 mph;
- (b) 1.017, when measured using either:
  - (i) The American Society for Testing and Materials (ASTM) of F2493-20 standard reference test tyre in accordance with ASTM Method E1337-19 at a speed of 40 mph; or
  - (ii) The k-test method specified in Appendix 2 to Annex 6 of UN Regulation No. 13-H.
- (c) **The required value to permit the design maximum deceleration of the relevant vehicle, when measured using the k-test method in Appendix 2 to Annex 13 of UN Regulation No. 13.”**

Paragraph 5.1.4., amend the title to read:

“5.1.4. Warnings **and information**”

Paragraph 5.2.1.1., amend to read:

“5.2.1.1. Collision warning

When ~~a~~ **an imminent** collision with a preceding vehicle of Category M<sub>1</sub>, in the same lane **is detected** with a relative speed above that speed up to which the subject vehicle is able to avoid the collision (**within the conditions specified in paragraphs 5.2.1.4.) is imminent**, a collision warning shall be provided as specified in paragraph 5.5.1., and shall be triggered at the latest 0.8 seconds before the start of emergency braking.

However...”

<sup>1</sup> As defined in the Consolidated Resolution on the Construction of Vehicles (R.E.3.), document ECE/TRANS/WP.29/78/Rev.6, para. 2 - [www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29gen/wp29resolutions.html)

Paragraph 5.2.1.2., amend to read:

“5.2.1.2. Emergency braking

“When the system has detected the possibility of an imminent collision, there shall be a braking demand of at least 5.0 m/s<sup>2</sup> to the service braking system of the vehicle. **This does not prohibit higher deceleration demand values than 5 m/s<sup>2</sup> during the collision warning for very short durations, e.g. as haptic warning to stimulate the driver’s attention.**

The emergency braking may be aborted **or the deceleration demand may be reduced below the threshold above (as relevant)**, if the conditions prevailing a collision are no longer present **or the risk of a collision has decreased**.

This shall be tested in accordance with paragraphs 6.4. and 6.5. of this Regulation”

Paragraph 5.2.1.4., amend to read:

“5.2.1.4. Speed reduction by braking demand

In absence of driver's input which would lead to interruption according to paragraph 5.3.2., the AEBS shall be able to achieve a relative impact speed that is less or equal to the maximum relative impact speed as shown in the following table, **provided:**

- ~~(a) For collisions with unobstructed and constantly travelling or stationary targets;~~
- ~~(b) On flat, horizontal and dry roads;~~
- ~~(c) In maximum mass and mass in running order conditions;~~
- ~~(d) In situations where the vehicle longitudinal centre planes are displaced by not more than 0.2m;~~
- ~~(e) In ambient illumination conditions of at least 1,000Lux without blinding of the sensors (e.g. direct blinding sunlight);~~
- ~~(f) In absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 0°C);~~
- ~~(g) When driving straight with no curve, and not turning at an intersection.~~

~~It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed above. However, the system shall not deactivate or unreasonably switch the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 3 of this Regulation.~~

- (a) Vehicle external influences allow for the required deceleration, i.e.:**
  - (i) The road is flat, horizontal and dry affording good adhesion;**
  - (ii) The weather conditions do not affect the dynamic performance of the vehicle (e.g. no storm, not below 0°C);**
- (b) The vehicle state itself allows for the required deceleration, e.g.:**
  - (i) The tyres are in an appropriate state and properly inflated;**
  - (ii) The brakes are properly operational (brake temperature, pads condition etc.);**
  - (iii) There is no severe uneven load distribution;**
  - (iv) No trailer is coupled to the motor vehicle and the mass of the motor vehicle is between maximum mass and mass in running order conditions;**

- (c) **There are no external influences affecting the physical sensing capabilities, i.e.:**
  - (i) **The ambient illumination conditions are at least 1000 Lux and there is no extreme blinding of the sensors (e.g. direct blinding sunlight, highly RADAR-reflective environment);**
  - (ii) **The target vehicle is not extreme with regard to the Radar Cross Section (RCS) or the shape/silhouette (e.g. below fifth percentile of RCS of all M<sub>1</sub> vehicles)**
  - (iii) **There are no significant weather conditions affecting the sensing capabilities of the vehicle (e.g. heavy rain, dense fog, snow, dirt);**
  - (iv) **There are no overhead obstructions close to the vehicle;**
- (d) **The situation is unambiguous, i.e.:**
  - (i) **The preceding vehicle belongs to Category M<sub>1</sub>, is unobstructed, clearly separated from other objects in the driving lane and constantly travelling or stationary;**
  - (ii) **The vehicle longitudinal centre planes are displaced by not more than 0.2 m;**
  - (iii) **The direction of travel is straight with no curve, and the vehicle is not turning at an intersection and following its lane.**

**When conditions deviate from those listed above, the system shall not deactivate or unreasonably switch the control strategy. This shall be demonstrated by the manufacturer in accordance with Annex 3 of this Regulation and, if deemed justified, may be followed by testing by the technical service in conditions deviating from those listed above or those in paragraph 6. The rationale for and the results of this verification testing shall be appended to the test report.**

...”

*Paragraph 5.2.2.1., amend to read:*

“5.2.2.1. Collision Warning

When the AEBS has detected the possibility of a collision with a pedestrian crossing the road at a constant speed of 5km/h (**within the conditions specified in paragraph 5.2.2.4.**) a collision warning shall be provided as specified in paragraph 5.5.1. and shall be provided no later than the start of emergency braking intervention.

The collision warning may be aborted if the conditions prevailing a collision are no longer present.”

*Paragraph 5.2.2.2., amend to read:*

“5.2.2.2. Emergency Braking

When the system has detected the possibility of an imminent collision, there shall be a braking demand of at least 5.0m/s<sup>2</sup> to the service braking system of the vehicle. **This does not prohibit higher deceleration demand values than 5 m/s<sup>2</sup> during the collision warning for very short durations, e.g. as haptic warning to stimulate the driver’s attention.**

The emergency braking may be aborted **or the deceleration demand may be reduced below the threshold above (as relevant)**, if the conditions prevailing a collision are no longer present **or the risk of a collision has decreased.**

This shall be tested in accordance with paragraph 6.6. of this Regulation.”

Paragraph 5.2.2.4., amend to read:

“5.2.2.4. Speed Reduction by Braking Demand

In absence of driver's input which would lead to interruption according to paragraph 5.3.2., the AEBS shall be able to achieve an impact speed that is less or equal to the maximum relative impact speed as shown in the following table, **provided:**

- ~~(a) With unobstructed perpendicularly crossing pedestrians with a lateral speed component of not more than 5km/h;~~
- ~~(b) In unambiguous situations (e.g. not multiple pedestrians);~~
- ~~(c) On flat, horizontal and dry roads;~~
- ~~(d) In maximum mass and mass in running order conditions;~~
- ~~(e) In situations where the anticipated impact point is displaced by not more than 0.2m compared to the vehicle longitudinal centre plane;~~
- ~~(f) In ambient illumination conditions of at least 2,000Lux without blinding of the sensors (e.g. direct blinding sunlight).~~
- ~~(g) In absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 0°C) and~~
- ~~(h) When driving straight with no curve, and not turning at an intersection.~~

~~It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed above. However the system shall not deactivate or unreasonably switch the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 3 of this Regulation.~~

- (a) Pedestrians are unobstructed and perpendicularly crossing with a lateral speed component of not more than 5 km/h;**
- (b) Vehicle external influences allow for the required deceleration, i.e.:**
  - (i) The road is flat, horizontal and dry affording good adhesion;**
  - (ii) The weather conditions do not affect the dynamic performance of the vehicle (e.g. no storm, not below 0°C);**
- (c) The vehicle state itself allows for the required deceleration, e.g.:**
  - (i) The tyres in an appropriate state and properly inflated;**
  - (ii) The brakes are properly operational (brake temperature, pads condition etc.);**
  - (iii) There is no severe uneven load distribution;**
  - (iv) No trailer is coupled to the motor vehicle and the mass of the motor vehicle is between maximum mass and mass in running order conditions;**
- (d) There are no external influences affecting the physical sensing capabilities, i.e.:**
  - (i) The ambient illumination conditions are at least 2000 Lux and there is no extreme blinding of the sensors (e.g. direct blinding sunlight, highly RADAR-reflective environment);**
  - (ii) There are no significant weather conditions affecting the sensing capabilities of the vehicle (e.g. heavy rain, dense fog, snow, dirt);**
  - (iii) There are no overhead obstructions close to the vehicle;**
- (e) The situation is unambiguous, i.e.:**

- (i) There are not multiple pedestrians crossing in front of the vehicle.
- (ii) The silhouette of the pedestrian and the type of movement relate to a human being.
- (iii) The anticipated impact point is displaced by not more than 0.2 m compared to the vehicle longitudinal centre plane.
- (iv) The direction of travel is straight with no curve, and the vehicle is not turning at an intersection and following its lane.
- (v) There are no multiple objects close by to the pedestrian and an unambiguous object separation is given.

When conditions deviate from those listed above, the system shall not deactivate or unreasonably switch the control strategy. This shall be demonstrated by the manufacturer in accordance with Annex 3 of this Regulation and, if deemed justified, may be followed by testing by the technical service in conditions deviating from those listed above or those in paragraph 6. The rationale for and the results of this verification testing shall be appended to the test report.

...”

*Insert a new paragraph 6.2.4., to read:*

**“6.2.4. The vehicle may be fitted with protective equipment that does not affect the results of the tests.”**

*Paragraph 6.4., amend to read:*

“6.4. Warning and Activation Test ...

...

The functional part of the test shall start:

- (a) **The subject vehicle travelling at the required test speed within the tolerances and within the lateral offset prescribed in this paragraph, and**
- (b) **A distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.**

**The tolerances shall be respected between the start of the functional part of the test and the system intervention.**

~~when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.~~

~~From the start of the functional part until the point of collision there shall be no adjustment to any control of the subject vehicle by the driver other than slight adjustments to the steering control to counteract any drifting.”~~

*Paragraph 6.5., amend to read:*

“6.5. Warning and Activation Test ...

...

The functional part of the test shall start:

- (a) **The subject vehicle travelling at the required test speed within the tolerances and within the lateral offset prescribed in this paragraph, and**
- (b) **A distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.**

**The tolerances shall be respected between the start of the functional part of the test and the system intervention.**

~~when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.~~

~~From the start of the functional part until the point of collision there shall be no adjustment to any control of the subject vehicle by the driver other than slight adjustments to the steering control to counteract any drifting.”~~

Paragraph 6.6.1., amend to read:

“6.6. Warning and Activation Test with a Pedestrian Target

6.6.1. The subject vehicle ...

...

The functional part of the test shall start:

- (a) **The subject vehicle travelling at the required test speed within the tolerances and within the lateral offset prescribed in this paragraph, and**
- (b) **A distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.**

**The tolerances shall be respected between the start of the functional part of the test and the system intervention.**

~~when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the collision point.~~

The pedestrian target ... and does not brake.

Tests shall be conducted with a vehicle travelling at speeds shown in the tables below for respectively M<sub>1</sub> and N<sub>1</sub> categories. **If this is deemed justified**, the technical service may test any other speeds listed in the table in paragraph 5.2.2.4. and within the prescribed speed range as defined in paragraph 5.2.2.3.

...

~~From the start of the functional part until the point of collision there shall be no adjustment to any control of the subject vehicle by the driver other than slight adjustments to the steering control to counteract any drifting.~~

...”

Paragraph 6.6.2., amend to read:

“6.6.2. The assessment of the impact speed shall **comply with** the actual contact point between the target and the vehicle, taking into account the vehicle shape **without additional protective equipment as permitted per paragraph 6.2.4.**”

## II. Justification

### A. Context

1. GRVA adopted at its twelfth session in May 2022 a revision of UN Regulation No. 131, as the 02 series of amendments, per document GRVA-12-50-Rev.1 (which became document ECE/TRANS/WP.29/2022/76). GRVA, at that session, requested the IWG on AEBS-HDV to transfer the relevant improvements into UN Regulation No. 152, as indicated in the revised terms of reference per document GRVA-12-10, item 8.

2. At the thirteenth session of GRVA, the IWG on AEBS-HCV tabled informal document GRVA-13-08 to amend the scope of UN Regulation No. 152, together with the transfer of some relevant improvements from UN Regulation No. 131. At this same session, the European Commission tabled document GRVA-12-30 to further align UN Regulation No. 152 to the greatest extent. GRVA then reviewed both documents and requested the two informal groups to accommodate the two documents in order to present a consolidated proposal for adoption at the fourteenth session of GRVA.

3. The present document fulfils this task for the 02 series of amendments to UN Regulation No. 152.

## **B. Detailed justification**

4. Paragraph 1: see GRVA-13-08, justification 2.

5. Paragraph 2.13.: the reference to the k-test method of Appendix 2 to Annex 13 of UN Regulation No. 13 is necessary for the vehicles of Category M<sub>2</sub>, and for those of Categories M<sub>3</sub>/N<sub>2</sub> with a maximum weight below or equal to 8 tons, equipped with hydraulic braking, since UN Regulation No. 152 will be an alternative to UN Regulation No. 131.

6. Paragraph 5.1.4.: the subparagraph 5.1.4.2. requires some “information” to be displayed to the driver. The title is aligned accordingly.

7. Paragraphs 5.2.1.2. and 5.2.2.2.:

(a) The first proposed amendment clarifies that some short jerks are permitted by the regulation as a haptic warning.

(b) The second proposed amendment increases the flexibility for the system to adapt to the evolving environment.

8. Paragraphs 5.2.1.4. and 5.2.2.4.: see GRVA-13-08, justification 3.a.

9. Paragraph 5.2.2.1.: see GRVA-13-08, justification 3.a.

10. Paragraphs 6.2.4. and 6.6.2. include new provisions taken from UN Regulation No. 131 relevant for light vehicles

11. Paragraphs 6.4., 6.5. and 6.6.1.: adapts the test method to the improvements transferred from UN Regulation No. 131 (tolerances, clarification), relevant for light vehicles.

12. Paragraph 6.6.2. includes:

(a) Editorial correction;

(b) New provision from UN Regulation No. 131 relevant for light vehicles.

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