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World Forum for Harmonization of Vehicle Regulations**Working Party on Automated/Autonomous and Connected Vehicles****Seventh session**

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Item 7 of the provisional agenda

Advanced Emergency Braking Systems**Proposal for Supplement 3 to the original text to
UN Regulation No. 152 (Advanced Emergency Braking
Systems for M₁ and N₁ vehicles)****Submitted by the experts from the Informal Working Group on
Advanced Emergency Braking Systems for vehicles of Categories M₁
and N₁***

The text reproduced below was prepared by the experts from the Informal Working Group on Advanced Emergency Braking Systems (AEBS) for vehicles of Categories M₁ and N₁ in order to improve the Appendix 2 Annex 3 for best assessing the robustness against false reaction, to introduce new provisions for automatic deactivation of AEBS, and to improve the text on a number of issues. The modifications to the existing text of the Regulation are marked in bold for new and strikethrough for deleted characters.

* In accordance with the programme of work of the Inland Transport Committee for 2020 as outlined in proposed programme budget for 2020 (A/74/6 (part V sect. 20) para 20.37), 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

Paragraphs 5.2. to 5.2.1.4., amend to read (including missing headings in the table for M₁ vehicles):

5.2. Specific Requirements

5.2.1. Car to car scenario

5.2.1.1. Collision warning

When a collision ...

...

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:

(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 0.2 m;

(e) In ambient illumination conditions of at least 1000 Lux without ~~direct~~ **direct 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); ~~and in absence of extreme driving conditions (e.g. harsh cornering).~~

(g) When driving straight with no curve, and not turning at an intersection.

It is recognised ...

Maximum relative Impact Speed (km/h) for M₁ vehicle*

Relative Speed (km/h)	Stationary/ Moving	
	Maximum mass	Mass in running order
10	0.00	0.00
...
60	35.00	35.00

All values in km/h

* For relative speeds ...”

Paragraphs 5.2.2. to 5.2.2.4., amend to read:

5.2.2. Car to pedestrian scenario

5.2.2.1. Collision warning

When the AEBS ...

...

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:

- (a) With unobstructed **perpendicularly** crossing pedestrians with a lateral speed component of not more than 5 km/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 0.2 m compared to the vehicle longitudinal centre plane;
- (f) In ambient illumination conditions of at least 2000 Lux without ~~direct~~ **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) In absence of extreme driving conditions (e.g. harsh cornering).~~
- (h) When driving straight with no curve, and not turning at an intersection.**

It is recognised...

Paragraphs 5.4. to 5.4.2., amend to read:

- 5.4. Deactivation
- 5.4.1. When a vehicle ...
- 5.4.2. When the vehicle is equipped with a means to automatically deactivate the AEBS function, for instance in situations such as off-road use, being towed, being operated on a dynamometer, being operated in a washing plant, in case of a non-detectable misalignment of sensors, **[or when the Electronic Stability Control is switched off,]** the following conditions shall apply as appropriate:

Insert a new paragraph 5.4.4., to read:

- 5.4.4. While automated driving functions are in longitudinal control of the vehicle (e.g. ALKS is active) the AEBS function may be suspended or its control strategies (i.e. braking demand, warning timing) adapted without indication to the driver, as long as it remains ensured that the vehicle provides at least the same collision avoidance capabilities as the AEBS function during manual operation.**

Paragraphs 6.1. to 6.1.1.1., amend to read (including “minimum” in footnote 3):

- 6.1. Test Conditions
- 6.1.1. The test shall ...
- 6.1.1.1. The road test surface shall have a nominal³ peak braking coefficient (PBC) of **at least 0.9**, unless otherwise specified, when measured using either:

Paragraphs 6.3 to 6.3.1., amend to read:

- 6.3. Test Targets
- 6.3.1. The target used for the vehicle detection tests shall be a regular high-volume series production passenger car of Category M₁ AA saloon, or alternatively a "soft target" representative of such a vehicle in terms of its identification characteristics applicable to the sensor system of the AEBS under test according to ~~ISO 19206-1:2018~~ **ISO 19206-3:2020**. The reference point for the location of the vehicle shall be the most rearward point on the centreline of the vehicle.

³ The "nominal" value is understood as being the **minimum** theoretical target value.”

Paragraph 6.4.1., delete the numbering and amend to read (including the addition of two tables):

6.4.1. The subject vehicle ...

Tests shall be conducted with a vehicle travelling at ~~20, 42 and 60 km/h (with a tolerance of +0/-2 km/h)~~ **speeds shown in the tables below for respectively M₁ and N₁ Categories**. If this is deemed justified, the technical service may test any other speeds listed in the tables in paragraph 5.2.1.4. and within the prescribed speed range as defined in paragraph 5.2.1.3.

Subject vehicle test speed for M₁ category in stationary target scenario

<i>Maximum mass</i>	<i>Mass in running order</i>
20	20
40	42
60	60

All values in km/h with a tolerance of +0/-2 km/h

Subject vehicle test speed for N₁ category in stationary target scenario

<i>Maximum mass</i>		<i>Mass in running order</i>	
<i>α > 1.3</i>	<i>α ≤ 1.3</i>	<i>α > 1.3</i>	<i>α ≤ 1.3</i>
20	20	20	20
38	30	42	35
60	60	60	60

All values in km/h with a tolerance of +0/-2 km/h

The functional part ...

Paragraph 6.5., amend to read (including the addition of two tables):

6.5. Warning and Activation Test with a Moving Vehicle Target

The subject vehicle ...

Tests shall be conducted with a vehicle travelling at ~~30 and 60 km/h~~ **speeds shown in the tables below for respectively M₁ and N₁ categories** and target travelling at 20 km/h (with a tolerance of +0/-2 km/h for both the subject and the target vehicles). If this is deemed justified, the Technical Service may test any other speeds for subject vehicle and target vehicle within the speed range as defined in paragraph 5.2.1.3.

Subject vehicle test speed for M₁ category in moving target scenario

<i>Maximum mass</i>	<i>Mass in running order</i>
30	30
60	60

All values in km/h with a tolerance of +0/-2 km/h

Subject vehicle test speed for N₁ category in moving target scenario

<i>Maximum mass</i>		<i>Mass in running order</i>	
<i>α > 1.3</i>	<i>α ≤ 1.3</i>	<i>α > 1.3</i>	<i>α ≤ 1.3</i>
30	30	30	30
58	50	60	55

All values in km/h with a tolerance of +0/-2 km/h

The functional part

Paragraphs 6.6. to 6.6.1., amend to read (including the addition of two tables):

6.6. Warning and Activation Test with a Pedestrian Target

6.6.1. The subject vehicle ...

Tests shall be conducted with a vehicle travelling at 20, 30 and 60 km/h (with a tolerance of +0/-2 km/h) **speeds shown in the tables below for respectively M₁ and N₁ categories.** 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 paragraphs 5.2.2.3.

Subject vehicle test speed for M₁ category in pedestrian target scenario

<i>Maximum mass</i>	<i>Mass in running order</i>
20	20
30	30
60	60

All values in km/h with a tolerance of +0/-2 km/h

Subject vehicle test speed for N₁ category in pedestrian target scenario

<i>Maximum mass</i>		<i>Mass in running order</i>	
$\alpha > 1.3$	$\alpha \leq 1.3$	$\alpha > 1.3$	$\alpha \leq 1.3$
20	20	20	20
30	N. A.	30	25
60	60	60	60

All values in km/h with a tolerance of +0/-2 km/h

From the start ...”

Annex 3,

Appendix 2,

Paragraphs 1 to 3, delete

Insert a new introductory paragraph, to read:

The following scenarios shall be used to assess the system’s strategies implemented in order to minimize the generation of false reactions. For each type of scenario the vehicle manufacturer shall explain the principle strategies implemented to ensure safety.

The manufacturer shall provide evidence (e.g. simulation results, real-world test data, track test data) of the system’s behaviour in the described types of scenarios. The parameters described in subparagraph 2 of each scenario shall be used as guidance if the Technical Service deems a demonstration of the scenario necessary.

Insert new Scenarios 1 to 4, to read:

Scenario 1

Left turn or Right turn at the intersection

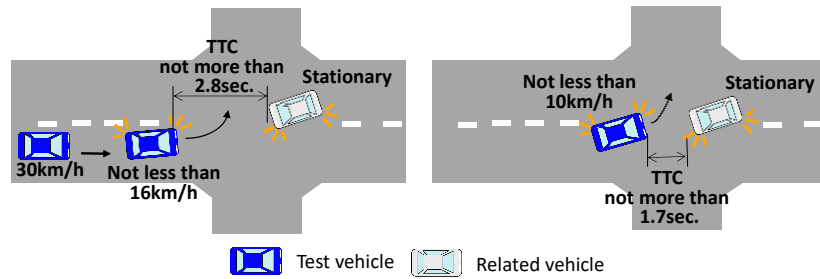
- 1.1. **In this scenario, the subject vehicle passes by a left turn or right turn in front of an oncoming vehicle that is stopped to make a left turn or right turn at an intersection.**
- 1.2. **An example of the detail scenario:**

The subject vehicle drives at a speed of 30 km/h (with a tolerance of +0/-2 km/h) toward the intersection, and decelerates by braking to a speed of not less than 16 km/h at a point where the subject vehicle begins to steer left / right, and the Time To Collision (TTC) to the oncoming vehicle is not more than 2.8 seconds. When the subject vehicle turns left or right in the intersection, the speed is reduced to not less than 10 km/h, and then drives at a constant speed. The TTC to the oncoming vehicle is not more than 1.7

seconds at when the wrap ratio between the subject vehicle and the oncoming vehicle becomes 0 per cent.

Figure 1: left turn or right turn at the intersection

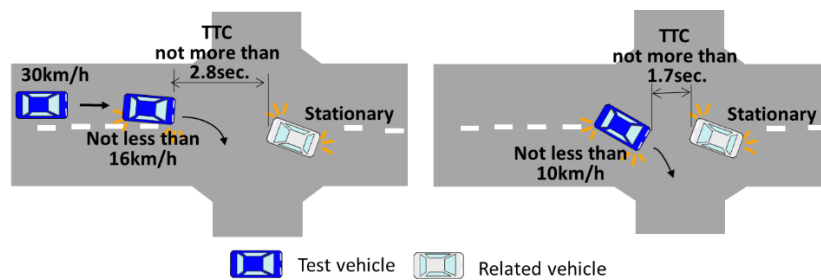
(A) Driving on right side of the road



1) Beginning to steer for right turn

2) Wrap ratio 0%

(B) Driving on left side of the road



1) Beginning to steer for right turn

2) Wrap ratio 0%

Scenario 2

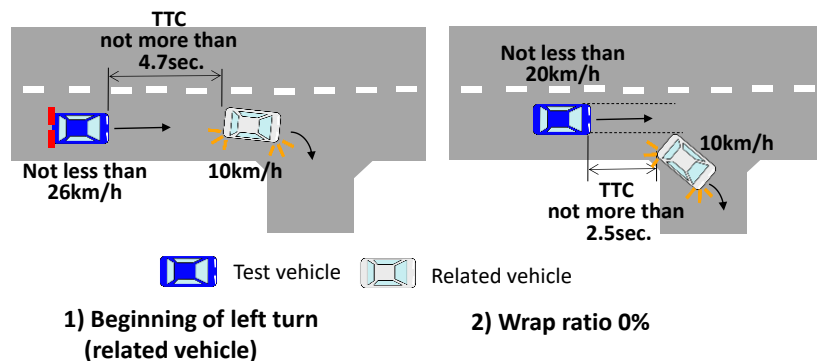
Right turn or Left turn of a forward vehicle

- 2.1. In this scenario, the subject vehicle follows a forward vehicle. After that, the forward vehicle turns right or left at a corner, and the subject vehicle goes straight.
- 2.2. An example of the detail scenario:

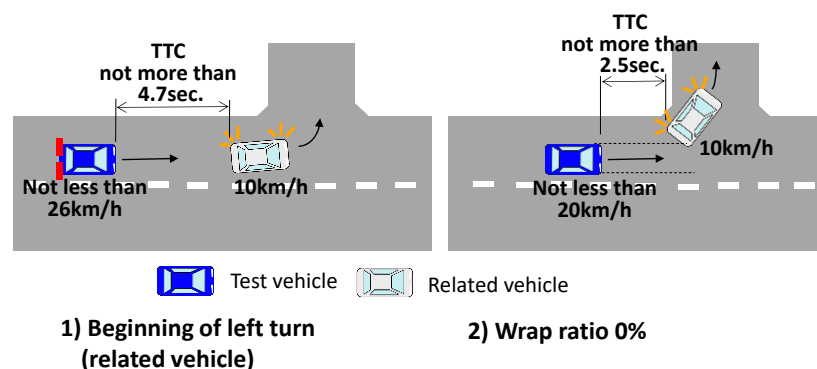
Both the forward vehicle and the subject vehicle drive at a speed of 40 km/h (with a tolerance of +0/-2 km/h) on the straight road. The forward vehicle decelerates by braking to a speed of 10 km/h (with a tolerance of +0/-2 km/h) in order to turn right or left at the corner, and the subject vehicle also decelerates by braking to keep appropriate distance with the forward vehicle. At when the forward vehicle begins to turn right or left, the speed of the subject vehicle is not less than 26 km/h and the TTC to the frontal vehicle is not more than 4.7 seconds. After that, the subject vehicle decelerates to a speed of not less than 20 km/h, and then drives at a constant speed. The TTC to the forward vehicle is not more than 2.5 seconds at when the wrap ratio between the subject vehicle and the forward vehicle becomes 0 per cent.

Figure 2: right turn or left turn of a forward vehicle

(A) Driving on right side of the road



(B) Driving on left side of the road



Scenario 3

Curved road with guard pipes and a stationary object

3.1. In this scenario, the subject vehicle drives a small radius curved road of which the guard pipes are constructed to the outer side, and a stationary vehicle (M₁ category), a stationary pedestrian target or a stationary bicycle target is positioned just outside of the guard pipes and where on the extension of the centre of the lane.

3.2. An example of the detail scenario:

The subject vehicle drives at a speed of 30 (with a tolerance of +0/-2 km/h) km/h toward the curve of which the radius is not more than 25 m at the outer side of the road, and decelerates by braking to a speed of not less than 22 km/h at a point where the subject vehicle enters the curve. The TTC to the stationary object is not more than 1.6 seconds at when the subject vehicle begins to turn in the curve. In the curve, the subject vehicle drives outer lane than the centre of the road. After that, the subject vehicle continue to turn in the curve at a constant speed of not less than 21 km/h. The TTC to the stationary object is not more than 1.1 second at when the wrap ratio between the subject vehicle and the stationary vehicle becomes 0%, or at when the offset ratio between the subject vehicle and the centre of the stationary pedestrian target or the stationary bicycle target becomes -100%.

Note: offset ratio between the subject vehicle and the stationary object is calculated by the following formula.

$$R_{\text{offset}} = L_{\text{offset}} / (0.5 * W_{\text{vehicle}}) * 100$$

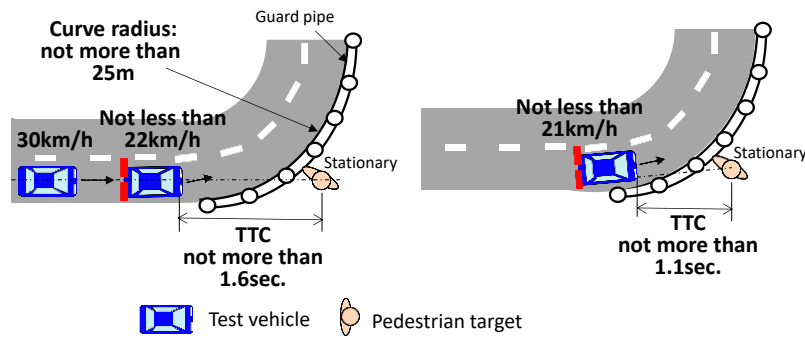
R_{offset} : Offset ratio [%]

L_{offset} : Amount of offset between the centre of the subject vehicle and the centre of the stationary object, and the direction of offset to the driver's seat side is defined as plus (+) [m]

W_{vehicle} : Width of the subject vehicle [m]

Figure 3: curved road with guard pipes and a stationary object

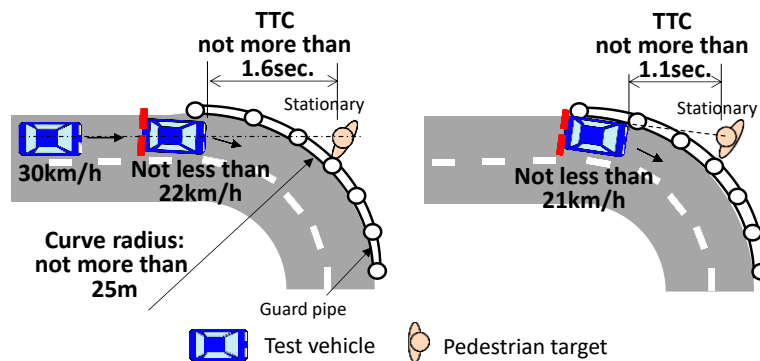
(A) Driving on right side of the road



1) Beginning to steer to turn left

2) Offset ratio -100%

(B) Driving on left side of the road



1) Beginning to steer to turn right

2) Offset ratio -100%

Scenario 4

Lane change due to road construction

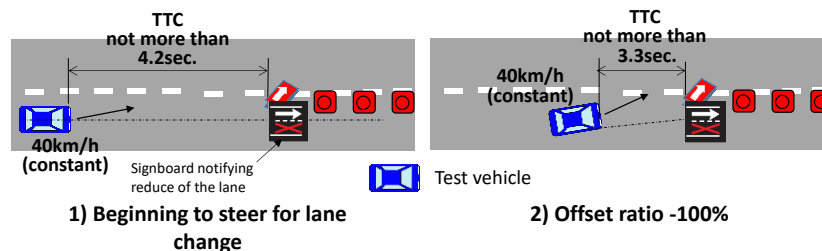
- 4.1. In this scenario, the subject vehicle changes the lane in front of the signboard which is positioned in the centre of the lane and notifies the driver that the lane is reduced.
- 4.2. An example of the detail scenario:

The subject vehicle drives a straight road at a speed of 40 km/h (with a tolerance of +0/-2 km/h), and begins to steer in order to change the lane in front of the signboard which notifies reducing the lane. No other vehicles approach the subject vehicle. The TTC to the signboard is not more than 4.2 seconds at when the subject vehicle begins to steer. During changing the lane, the speed of the subject vehicle is constant, and the TTC to the

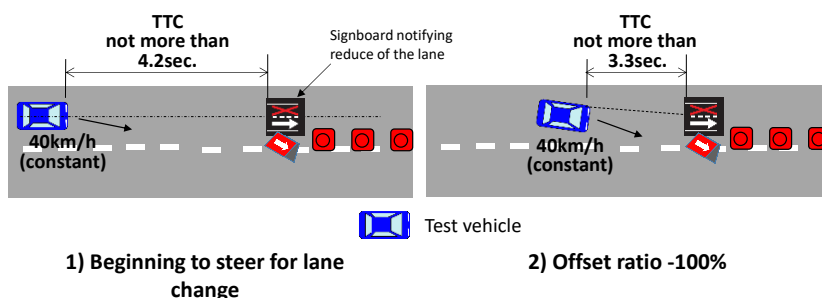
signboard is not more than 3.3 seconds at when the offset ratio between the subject vehicle and the centre of the signboard becomes -100 per cent.

Figure 4: lane change due to road construction

(A) Driving on right side of the road



(B) Driving on left side of the road



II. Justifications

1. Paragraph 5.2.1.4.(e): refining the wording since the light affecting the sensor can be indirect; the direct sunlight is only an example
2. Paragraph 5.2.1.4.(f): attempts to further discriminate the relevant affecting parameters in order to avoid large exemptions. Technically, two effects are simultaneously at stake:
 - (a) The yaw movement of the sensor attached to the vehicle can create a “ghost” movement in the perception of a stationary (or slow moving) obstacle
 - (b) In the case of a turning event (e.g. at a junction or in a parking) an obstacle can remain out of the field of detection until the very end of the manoeuvre.
3. Paragraph 5.2.1.4. (the table): corrects an editorial error since the headings of the columns are missing while the working document was correct. Another editorial error exists in paragraph 6.2.2.1. where the word “calibrate” is written in strikethrough while it should be deleted from the text.
4. Paragraph 5.2.2.4 (a): clarifies that the pedestrian’s path is assumed to be broadly perpendicular to the ego vehicle’s path for avoiding the effect of an unexpected component of movement.
5. Paragraphs 5.4.2.: as it can be opportune to manually deactivate the Electronic Stability Control (ESC) in certain particular circumstances, the AEBS should consequently be automatically deactivated through the ESC deactivation. The proposal is to make this operation an “automatic AEBS deactivation” in this regulation. This proposal is between square brackets since it needs further development until the seventh session of the working party.
6. Paragraph 5.4.4.: proposal to clarify the understanding of the AEBS functioning when assistance systems are in operation: “when a longitudinal control system is active, the vehicle deceleration may be smooth enough not to reach the requested 5 m/s² (paragraph 5.2.2.2.)

hence making the AEBS superfluous. Of course, AEBS remains in veil and intervenes in case of sudden unexpected event”.

7. Paragraph 6.3.1.: updating the reference to the ISO standard
8. Paragraph 6.4.1.:
 - (a) Numbering should have been deleted, editorial error;
 - (b) Adaptation of the text to the speeds indicated in section on requirements.
9. Paragraphs 6.5. and 6.6.1.: see above.
10. Annex 3, Appendix 2: proposal for new scenarios for assessing the robustness against false reaction, in the context of the Complex Electronic annex (Annex 3). These scenarios are given as a guidance for the Technical Services to cross-check the manufacturer’s documentation against real track tests. They are based on the Japanese study per working paper AEBS-13-07.
