

UN Regulation No. 131

Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking System (AEBS) for M₂, M₃, N₂ and N₃ vehicles^[EP1]

Introduction

The ^[SP2]~~[EP3]~~intention of the original **and this revised**^[EP4] Regulation is to establish uniform provisions for advanced emergency braking systems (AEBS) fitted to motor vehicles of the categories M₂, M₃, N₂ and N₃ primarily used under highway conditions.

The system shall automatically detect a potential forward collision with another vehicle ~~or~~**and** **with**^[EP5] a pedestrian crossing the path of the vehicle, provide the driver with a warning **if time permits**^[EP6] and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating the severity of a collision, even if the driver does not respond to the warning.

The system shall only operate in driving situations where braking will avoid or mitigate the severity of an accident, and shall take no action in normal driving situations.

In the case of a failure in the system, the safe operation of the vehicle shall not be endangered.

The system shall provide as a minimum an acoustic or haptic warning, which may also be a sharp deceleration, so that an inattentive driver is made aware of a critical situation, if time permits. There are, however, situations where a warning cannot be given in time for the driver to appropriately react, such as pedestrian collisions or collisions with strongly decelerating preceding vehicles. In these cases, the warning may be given at the time that an automated brake intervention starts.

During any action taken by the system (the warning and emergency braking phases), the driver can, at any time through a conscious action like an accelerator kick-down or ~~a swerving action that results in enough change of direction~~ ~~to~~ not **to** hit the target, take control and override the system^[EP7].

While from a traffic safety perspective, it would be appreciable to require automated collision avoidance for all heavy vehicles up to their maximum driving speed, it is acknowledged that the avoidance of false positive reactions as well as constraints such as for example imperfect sensor systems limit the possible performance. However, active safety systems in general have made a giant leap over the last decade with respect to their performance in avoiding or mitigating accidents with an ever increasing variety of collision partners.

Therefore there shall be an ambition to produce active safety systems that go beyond what is required in this revision of Regulation 131, namely: to avoid accidents with other vehicles up to the maximum driving speed, **to** avoid accidents with pedestrians up to speeds comparable to those required from passenger cars (see Regulation 152), **to avoid collisions with pedestrians crossing directly in front of a stationary truck (motion inhibit)** and finally to introduce automated braking systems avoiding bicycle accidents for heavy vehicles. To support this ambition, the state of technology should be closely monitored and requirements in this regulation appropriately ^{adopted}~~[WU8]~~.

1. Scope

This Regulation applies to the approval of vehicles of Category M₂, M₃, N₂ and N₃¹ with regard to an on-board system to

- (a) Avoid or mitigate the severity of a rear-end in lane collision with a preceding vehicle,
- (b) Avoid or mitigate the severity of an impact with a pedestrian. */

*/ For vehicles of category M₂, and for those of category M₃/N₂ with a maximum weight below or equal to 8t, equipped [with M1/N1 type hydraulic braking]EP9], Contracting Parties that are signatories to both Regulation No. 152 and this Regulation shall recognize approvals to either Regulation as equally valid.

5. Specifications

5.2. Specific Requirements

5.2.1.4. [SP10] 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, **decelerating**EP11] or stationary targets;
- (b) On flat, horizontal and dry roads affording good adhesion **as well as on wet**EP12] **roads;**
- (c) [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;]SP13]
- (d) In situations where the anticipated impact point is displaced by not more than [0.2]EP14] **±1.5**]SP15] m compared to the vehicle longitudinal centre plane;
- (e) In ambient illumination conditions of at least 1000 Lux 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
- [(h) In unambiguous situations (e.g. not multiple potential targets).]SP16]
- (i) [In absence of conditions resulting from the usage of the vehicle which are directly affecting the braking performance (e.g. brake temperature, severe uneven load distribution)]SP17]

It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed aboveEP18]. However, the system shall not deactivate or unreasonably switch the control strategy in these

¹ 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

other conditions. This shall be demonstrated in accordance with Annex 3 of this Regulation.]

Maximum [SP19] relative Impact Speed (km/h) (regardless whether target stationary or moving)*

Relative Speed (km/h)	$M_2N_2, M_3 < 8t$ with hydraulic brake			M_3N_3 (without $M_3 < 8$ ton with hydraulic brake)
	Vehicle derived from M1/N1	Vehicle derived from M3/N3 & pneumatic brake	Vehicle derived from M3/N**3 & hydraulic brake, [EP20]M3 & hydraulic brake	
10	0	0	0	0
20	0	0	0	0
30	0	0	0	0
35	0	0	0	0
40	0	0	15	0
50	0	0	28	0
60	25	0	40	0
70	37	0	50	0
80	49	28	61	28
90	60	42	71	42
100	71	54	82	54

5.2.2. Vehicle to pedestrian scenario

5.2.2.1. [SP21] Collision warning

When the AEBS has detected the possibility of a collision with a pedestrian crossing the road at a constant speed of not more than $5 \text{ km/h} \pm 2 \text{ km/h}$ [WU22], within the conditions specified in paragraph 5.2.2.4., a collision warning as specified in paragraph 5.5.1. shall be provided no later than the start of the emergency braking.

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

[SP23] 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:

- With unobstructed perpendicularly crossing pedestrians with a lateral speed component of not more than 5 km/h;
- In unambiguous situations (e.g. not multiple pedestrians);
- On flat, horizontal and dry roads affording good adhesion;
- 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; [SP24]

- (e) In situations where the anticipated impact point is displaced by not more than $[0,2 \text{ m}]_{\text{EP25}}$ $[\text{SP26}]$ compared to the vehicle longitudinal centre plane;
- (f) In ambient illumination conditions of at least 2000 Lux without blinding of the sensors (e.g. direct blinding sunlight).
- (g) In absence of weather conditions affecting the dynamic 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.
- (i) In absence of situations resulting from the usage of the vehicle which are directly affecting the braking performance (e.g. brake temperature, severe uneven load distribution) $[\text{SP27}]$

It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed $[\text{WU28}]$. 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.]

5.3. Interruption by the Driver

5.3.1. The AEBS shall $[\text{SP29}]$ provide the means for the driver to **suppress the audible collision warnings but** **such action shall not at the same time suppress system functions other than audible warnings** $[\text{WU30}]$.

5.3.2. The AEBS shall provide **appropriate/robust** means for the driver to **override** $[\text{EP31}]$ ~~interrupt~~ the emergency braking phase.

5.3.3. In both cases above, this **prevention or overriding interruption** may be initiated by **a any positive action (e.g. kick-down or early and safe evasive manoeuvre)** $[\text{EP32}]$ ~~operating the direction indicator control~~ that indicates that the driver is aware of the emergency situation. The vehicle manufacturer shall provide a list of **these positive actions (and evidence that e.g. the evasive manoeuvre by the driver is sufficient)** $[\text{WU33}]$ **to avoid the collision** to the technical service at the time of type approval and it shall be annexed to the test report.

5.4. Deactivation

5.4.1. When a vehicle is equipped with a means to manually deactivate the AEBS function, the following conditions shall apply as appropriate:

5.4.1.1. **The AEBS shall be in normal operation mode upon each activation of the vehicle master** control $[\text{EP34}]$

5.4.1.2. The AEBS deactivation control shall be designed in such a way that manual deactivation by the driver shall be carried out **by a sequence and** $[\text{EP35}]$ not be possible with less than two deliberate actions.

5.4.1.3. It shall not be possible to manually deactivate the AEBS at a speed above $[\text{10Y}]$ $[\text{EP36}]$ km/h.]

5.4.1.4 **After any deactivation** the AEBS function shall be **reactivated as soon as possible, but – if not manually by the driver – automatically reinstated not later than within [X] seconds/minutes and**

when reaching driving speed above [Y] km/h and ^[EP37]
at the latest at the initiation of each new ignition cycle.

- 5.4.2.3. Where automatic deactivation of the AEBS function is a consequence of the driver manually switching off the **ABS by switching off the**^[EP38] ESC function of the vehicle, this deactivation of the AEBS shall require at least two deliberate actions by the driver.
- 5.5.3. Where an optical means is used as part of the collision warning⁴, the optical signal may be the flashing of the failure warning signal specified in paragraph 5.5.4.

6. Test procedure

6.1. Test Conditions

6.1.1. The test shall be performed on a flat, dry concrete or asphalt surface affording good adhesion.

Additional test shall be performed on a flat and wet concrete or asphalt surface to verify the required or just slightly degraded performance.

6.1.5. Natural ambient illumination must be homogeneous in the test area and in excess of 1000 lux in the case of vehicle to ~~car~~ vehicle scenario as stipulated in paragraph 5.2.1. and of 2000 lux in the case of vehicle to pedestrian scenario as stipulated in paragraph 5.2.2. and of 2000 lux in the case of vehicle to bicycle scenario as stipulated in paragraph 5.2.3. It should be ensured that testing is not performed whilst driving towards, or away from the sun at a low angle.

6.4. Warning and Activation Test with a Stationary Vehicle Target

The subject vehicle shall approach the stationary target in a straight line for at least two seconds prior to the functional part of the test with a subject vehicle to target centreline offset of not more than 0.25 m.

Tests shall be conducted with a vehicle travelling at speeds shown in tables below for respectively M₂, M₃, N₂ and N₃ 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 M₂ and M₃ vehicle in stationary target scenario

M ₂			M ₃		
Maximum mass	Mass in running order	Tolerance	Maximum mass	Mass in running order	Tolerance

All values in km/h

Discussion point:
 Table will be update based on the requirement table.
 The test confirms the minimum speed, the maximum collision avoidance, the maximum speed in R152.

Subject vehicle test speed for N₂ and N₃ vehicle in stationary target scenario

N ₂			N ₃		
Maximum mass	Mass in running order	Tolerance	Maximum mass	Mass in running order	Tolerance

All values in km/h

Discussion point:
 Table will be update based on the requirement table.
 The test confirms the minimum speed, the maximum collision avoidance, the maximum speed in R152.

The functional part of the test shall start 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.
[SP47][WU48]

6.6. Warning and Activation Test with a Pedestrian Target

- 6.6.1. The subject vehicle shall approach the impact point with the pedestrian target in a straight line for at least two seconds prior to the functional part of the test with an anticipated subject vehicle to impact point centreline offset of not more than 0.1 m.
[TP49][SP50]

The functional part of the test shall start when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a TTC of at least 4 seconds from the collision point.

The pedestrian target shall travel in a straight line perpendicular to the subject vehicle's direction of travel at a constant speed [WU51] of 5 km/h +20.4/-20.4 km/h, starting not before the functional part of the test has started. The pedestrian target's positioning shall ...

Tests shall be conducted with a vehicle travelling at speeds shown in tables below for respectively M₂, M₃, N₂ and N₃ 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.

6.10. [TP52][SP53] Robustness of the system

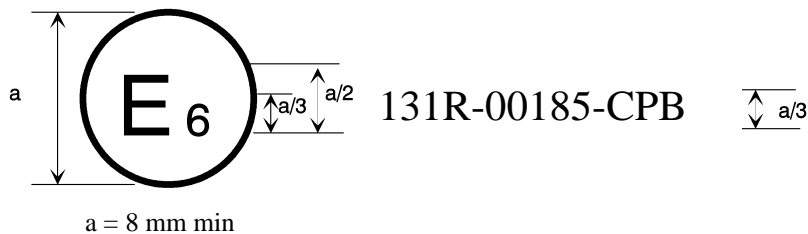
- 6.10.1. Any of the above test scenarios, where a scenario describes one test setup at one subject vehicle speed at one load condition of one category (Vehicle to ~~Car~~ Vehicle, [TP54][SP55][EP56] Vehicle to Pedestrian, Vehicle to Bicycle), shall be performed two times. If one of the two test runs fails to meet the required performance, the test may be repeated once. A test scenario shall be accounted as passed if the required performance is met in two test runs. The number of failed tests runs within one category shall not exceed:

- (a) 10.0 per cent of the performed test runs for the Vehicle to ~~Car~~ Vehicle tests;
- (b) 10.0 per cent of the performed test runs for the Vehicle to Pedestrian tests; and
- (c) 20.0 per cent of the performed test runs for the Vehicle to Bicycle tests.

Annex 2

Arrangements of approval marks

(see paragraphs 4.4. to 4.4.2. of this Regulation)



The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E 6) with regard to the Advanced Emergency Braking Systems (AEBS) pursuant to UN Regulation No. 131 (marked with C for Vehicle to **Car Vehicle**, P for Vehicle to Pedestrian, B for Vehicle to Bicycle). The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of UN Regulation No. 131 in its origin

