



AEBS-08 – Industry Input

AEB IWG 08 – Industry Input

Maximum required system performance

(GRVA-02-22e V. and VII. Proposal)



Does this mean whenever the 5 conditions are fulfilled, the system shall deliver maximum performance?

Trailer operation



Ambient Illumination



Driver Intervention



5.2.1.4. Speed reduction by braking demand

When the system is activated, the AEBS shall be able to achieve the maximum relative impact speed as shown in the following table:

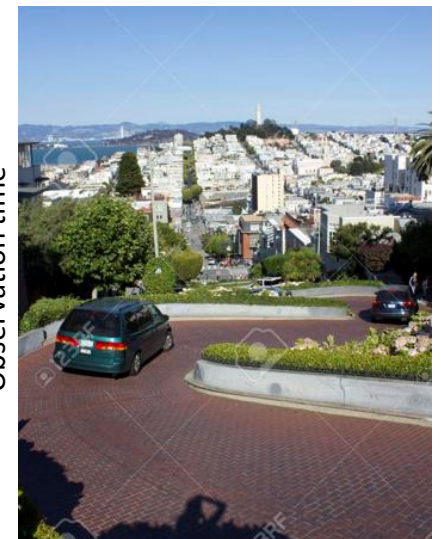
- for collisions with constantly travelling or stationary targets;
- on dry roads;
- in laden and unladen conditions;
- in situations where the vehicle longitudinal centre planes are displaced by not more than 0.2 m; and/or
- in ambient illumination conditions of at least 1000 Lux.

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 drastically change the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 3 of this Regulation.

Slope



Observation time



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Condition	Criteria for <u>Test Section</u>	Criteria in the <u>General Provisions</u>
Road surface	Flat	-
	dry	dry
	Good adhesion (PBC of 0.9)	Implicitly by dry
	Consistent slope between level and 1%	-
Ambient Air temperature	Between 0-45°C	-
Horizontal visibility range	Allow the target to be observed throughout the test	-
Wind	No wind liable	-
Ambient illumination	Homogenous	-
	In excess of 1000lux (car2car) or 2000lux (car2ped)	In excess of 1000lux (car2car) or 2000lux (car2ped)
Test weight	Laden and unladen	Laden and unladen
	Load distributed according to manufacturers recommendation	-
Brake	A sequence of brake activations	-
Target	Specified, constantly travelling	Constantly travelling
Scenario (e.g. displacement of centerlines)	0,2m (car2car)	Displacement of max. 0,2m
Vehicle Speed	Constant	-
Observation Time	At least 4s TTC	-

A lot of conditions remain undefined in the requirements section, yet it requires maximum performance!

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(GRVA-02-22e V. and VII. Proposal)



Alternative proposal for paragraph 5.2.1.4 (5.2.2.4 to be adapted accordingly)

5.2.1.4. Speed reduction by braking demand

When the system is activated, the AEBS shall be able to achieve the maximum relative impact speed as shown in the ~~following~~ table ~~below~~.

~~— for collisions with constantly travelling or stationary targets;~~

~~— on dry roads;~~

~~— in laden and unladen conditions;~~

~~— in situations where the vehicle longitudinal centre planes are displaced by not more than 0.2 m; and/or~~

~~— in ambient illumination conditions of at least 1000 Lux.~~

It is recognised that the performances required in this table may not be fully achieved in ~~case the conditions deviate from those described in the test procedure in paragraph 6 or in case other conditions [not mentioned in this regulation] affect the performance of the system (e.g. trailer hitched to the vehicle)~~ ~~other conditions than those listed above~~.

However, the system shall not deactivate or ~~drastically~~ ~~unreasonably~~ change the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 3 of this Regulation.

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Justification for need of repetition of single tests
(GRVA-02-22e IX. Proposal)



What is the problem?

► **Goal:**

Make sure that systems meeting minimum safety requirements pass homologation

► **Problem:**

Mandating a large number of test cases that all need to be passed in a single test run to qualify for homologation might lead to problems for vehicles with otherwise good AEB systems.

Due to the nature of systems relying on environment sensors the probability to pass a test is (slightly) slower than 100%.

► **Proposal:**

Change the “all test cases need to be passed at only a single test run” rule into a “minimum two test runs of out three need to be passed” rule

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(GRVA-02-22e IX. Proposal)



Single test per test case => 9,6% chance of homologation failure

- ▶ Mandating a large number of test cases that all need to be passed in a single test run to qualify for homologation might lead to problems for vehicles with otherwise good AEB systems.
- ▶ Let us assume the following parameters (example, not a real system):
 - ▶ Probability p_{single} to pass a single test case $p_{\text{single}} = 99\%$
even an otherwise good AEBS system might fail single tests, as this is a design constraint of systems based on environment sensors
 - ▶ Total number of tests n needed for homologation $n = 10$
 - ▶ Probability p_{fail} to fail homologation (with an otherwise good system)

$$p_{\text{fail}} = 1 - p_{\text{single}}^n = 1 - 99\%^{10} = 9,6\%$$

=> Almost **one out of ten vehicles** (with an otherwise good system) **will fail homologation!**

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Justification for need of repetition of single tests
(GRVA-02-22e IX. Proposal)



Two out of three per test case

▶ If you allow per test case a two out of three rule for tests to be passed:

▶ Using the same parameter:

▶ Probability p_{single} to pass a single test case

$$p_{\text{single}} = 99\%$$

even an otherwise good AEBS system might fail single tests, as this is a design constraint of systems based on environment sensors

▶ Test case is passed for:

Pass	Pass	Pass	in the three single tests
Pass	Pass	Fail	in the three single tests
Pass	Fail	Pass	in the three single tests
Fail	Pass	Pass	in the three single tests

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2 out of 3 per test case => 0,3% chance of homologation failure

► Probability p_{pass} to pass a test case:

$$p_{\text{pass}} = p_{\text{single}}^3 + 3 * p_{\text{single}}^2 * (1 - p_{\text{single}}) = 97,03\% + 2,94\% = \mathbf{99,97\%}$$

(Pass*Pass*Pass + Pass*Pass*Fail + Pass*Fail*Pass + Fail*Pass*Pass)

► Probability p_{fail} to fail homologation (with the same system!)

$$p_{\text{fail}} = 1 - p_{\text{pass}}^n = 1 - 99,97\%^{10} = \mathbf{0,3\%}$$

=> Only three out of 1000 vehicles (with an otherwise good system) will fail homologation!

AEB IWG 08 – Industry Input

Justification for need of repetition of single tests
(GRVA-02-22e IX. Proposal)



Does this make AEB systems less effective?

- ▶ „Wait a minute! This means that the system will be quite bad, as it only needs to work for 66% of all tests!“
- ▶ Let's do the same math with 66% for p_{single} : $p_{\text{single}} = 66\%$
- ▶ Probability p_{pass} to pass a single test case:

$$p_{\text{pass}} = p_{\text{single}}^3 + 3 * p_{\text{single}}^2 * (1 - p_{\text{single}}) = 28,75\% + 43,12\% = \mathbf{71,87\%}$$

- ▶ Probability p_{fail} to fail homologation (with a system with only 66% probability to pass a single test):

$$p_{\text{fail}} = 1 - p_{\text{pass}}^n = 1 - 71,87\%^{10} = \mathbf{96,32\%} \quad \Rightarrow \text{Almost all cars would fail homologation!}$$

Limiting the max. number of failed tests could address the concern, that this would otherwise allow systems with insufficient performance to the market.

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Justification for need of repetition of single tests
(GRVA-02-22e IX. Proposal)



Alternative Approaches could be:

- ▶ Specify that in case of a failed test it shall be agreed between the manufacturer and the Technical Service how many repetitions of this test are suitable.
- ▶ Define an overall percentage of tests that must be passed/may be failed.
- ▶ Define a different approval scheme (e.g. 3 out of 4 must be passed)

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Additional items not referenced in GRVA-02-22e



„Manual and Automatic Deactivation“ instead of „Manual Deactivation“

- 5.4. Manual **and Automatic** 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 function shall be automatically reinstated at the initiation of each new ignition cycle.
 - 5.4.1.2. The AEBS control shall be designed a in such a way that manual deactivation shall not be possible with less than two deliberate actions.
 - 5.4.1.3. The AEBS control shall be installed so as to comply with the relevant requirements and transitional provisions of UN Regulation No. 121 in its 01 series of amendments or any later series of amendments.
 - 5.4.1.4. It shall not be possible to deactivate the AEBS at a speed above 10 km/h.
 - 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, the following conditions shall apply as appropriate:
 - 5.4.2.1. The vehicle manufacturer shall provide a list of situations and corresponding criteria where the AEBS function is automatically deactivated to the technical service at the time of type approval and it shall be annexed to the test report.
 - 5.4.2.2. The AEBS function shall be automatically reactivated as soon as the conditions that led to the automatic deactivation are not present anymore.
 - 5.4.3. A constant optical warning signal shall inform the driver that the AEBS function has been deactivated. The yellow warning signal specified in paragraph 5.5.4. below may be used for this purpose.

Since 5.4. contains provisions for **manual** and **automatic deactivation**, the section should be titled „Manual and Automatic Deactivation“.

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Additional items not referenced in GRVA-02-22e

Articulated Pedestrian Target optional as according to ISO



- 6.3.2. The targets used for the pedestrian detection tests shall be a "soft target" and be representative of the human attributes applicable to the sensor system of the AEBS under test according to ISO DIS 19206-2:2018.

In accordance with ISO DIS 19206-2:2018 the manufacturer shall declare whether to use an articulated on non-articulated pedestrian target.

- 6.3.3. Details that enable the target(s) to be specifically identified and reproduced shall be recorded in the vehicle type approval documentation.

Justification:

The AEBS system might not work properly if the target used doesn't show realistic features or creates inconsistencies (moves but doesn't move its legs), which could be possible when using a non-articulated pedestrian target. Since both are covered by the referenced standard, the manufacturer should declare what type to use.



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Additional items not referenced in GRVA-02-22e

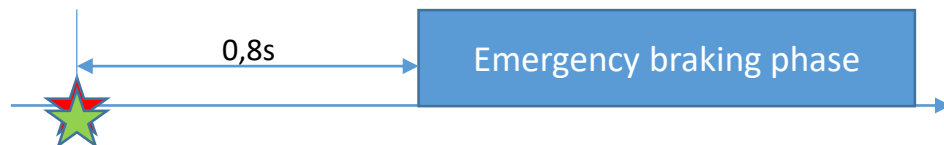


Time Needed for Providing the Collision Warning after a Situation was Anticipated

5.2.1.1. Collision warning

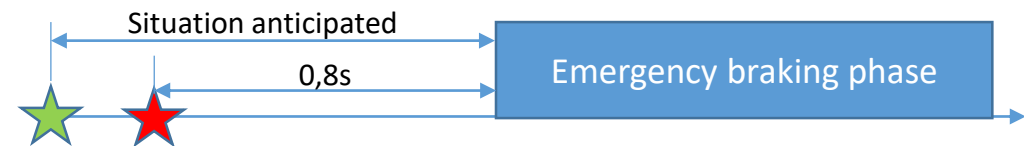
When a collision with a preceding vehicle of Category M1, in the same lane with a relative speed above that speed up to which the subject vehicle is able to avoid the collision, ~~can be anticipated 0.8 seconds ahead of an emergency braking~~, is imminent ~~a~~ **the** collision warning shall be **triggered** as specified in Paragraph 5.5.1., and shall be provided at the latest 0.8 seconds before the start of emergency braking.

However, in case the collision cannot be anticipated ~~0.8 in time to give a collision warning 0,8~~ seconds ahead of an emergency braking, ~~the collision warning shall be issued immediately after the detection.~~ **[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.]**



Current wording:

The warning would have to be given the exact same moment the situation could be anticipated



Suggested wording:

In order to be able to give the warning at 0,8s, the situation would have to be anticipated much earlier, because the system needs time for detection, decision making and activating the warning.

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Maximum speed reduction above the avoidance speed for Car 2 Ped Step 2
(GRVA-02-22e XIII. Proposal)

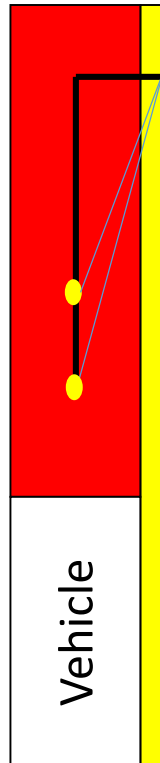


1. Requiring such a high speed reduction will force the systems to start an intervention even when unsure of the situation, which will potentially be a **risk for false interventions**.

Subject vehicle speed (km/h)	Laden	Unladen
20	0.00	0.00
25	0.00	0.00
30	0.00	0.00
35	0.00	0.00
40	0.00	0.00
42	10.00 27.00	0.00
45	15.00 30.00	15.00 30.00
50	25.00 35.00	25.00 35.00
55	30.00 40.00	30.00 40.00
60	35.00 45.00	35.00 45.00

From GRVA-02-22, for M1 Car2Ped Step 2, N2 accordingly

5m more decision time

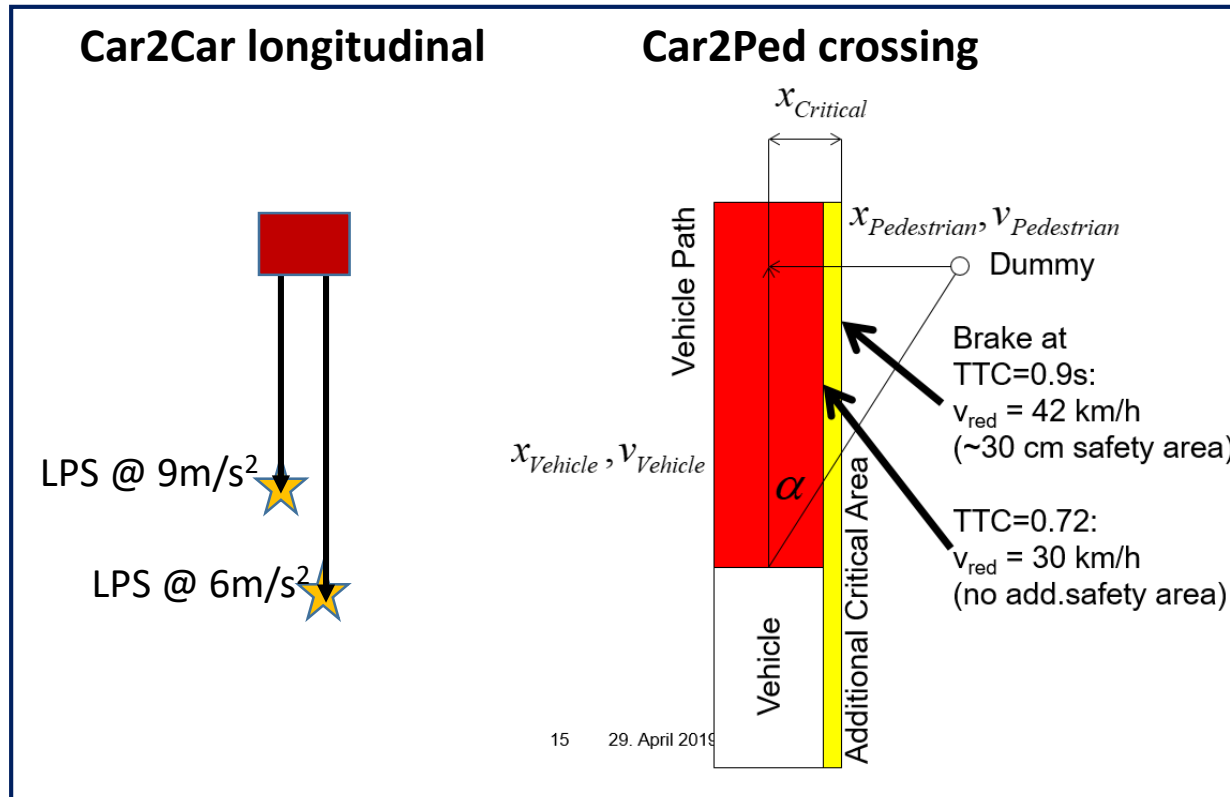


➤ The required speed reduction suggested by Industry would give the system about **5m** additional time to evaluate the situation.

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Maximum speed reduction above the avoidance speed for Car 2 Ped Step 2
(GRVA-02-22e XIII. Proposal)

- 2. The assumed deceleration has a much higher influence on the Car2Ped scenario, because the LastPointToSteer isn't relevant.



Subject vehicle speed (km/h)	Laden	Unladen
20	0.00	0.00
25	0.00	0.00
30	0.00	0.00
35	0.00	0.00
40	0.00	0.00
42	10.00 27.00	0.00
45	[15.00 30.00]	[15.00 30.00]
50	[25.00 35.00]	[25.00 35.00]
55	[30.00 40.00]	[30.00 40.00]
60	[35.00 45.00]	[35.00 45.00]

- Brake intervention starts always at the same speed-dependent distance to the point of impact.
- If only a deceleration of $6,43\text{m/s}^2$ (5 m/s^2) was achievable, this would result in lower possible speed reduction, as suggested by Industry.