

# UNITED NATIONS

## AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM TECHNICAL PRESCRIPTIONS FOR WHEELED VEHICLES, EQUIPMENT AND PARTS WHICH CAN BE FITTED AND/OR BE USED ON WHEELED VEHICLES AND THE CONDITIONS FOR RECIPROCAL RECOGNITION OF APPROVALS GRANTED ON THE BASIS OF THESE PRESCRIPTIONS\*

Addendum: **XXX**: Regulation: **XXX-00**

Date of entry into force as an annex to the Agreement: **XXX**

REGULATION ON UNIFORM PROVISIONS CONCERNING THE APPROVAL OF MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEM (AEBS)



UNITED NATIONS

Colour code:

- **Red:** internal references to be further cross-checked at the end of the exercise
- [ ]: items and values still to be affixed by the informal group.
- ~~Strikethrough:~~ deleted text compared to the previous version of the document
- **Bold:** added text compared to the previous version of the paragraph (except some titles)
- *Italic:* Note of the Secretariat

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\* Former title of the Agreement: Agreement Concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, done at Geneva on 20 March 1958.

## REGULATION No. XXX-00

### UNIFORM PROVISIONS CONCERNING THE APPROVAL OF: MOTOR VEHICLES WITH REGARD TO THE ADVANCED EMERGENCY BRAKING SYSTEMS (AEBS)

#### INTRODUCTION

The intention of this Regulation is to establish uniform provisions for Advanced Emergency Braking Systems (AEBS) fitted to motor vehicles of the Categories M1 and N1 primarily used within urban driving conditions.

The system shall automatically detect a potential forward collision, provide the driver with an appropriate warning and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating the severity of a collision in the event that the driver does not respond to the warning.

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

During any action taken by the system (~~the collision warning and emergency braking phases~~), the driver can, at any time through a conscious action, e.g. by a steering action or an accelerator kick-down, take control and override the system.

The Regulation cannot ~~test include~~ all the traffic conditions and infrastructure features in the type-approval process; **the regulation recognises that the performances required in this regulation cannot be achieved in all conditions (vehicle condition, road adhesion, weather conditions, deteriorated road infrastructure and traffic scenarios etc. may affect the system performances)**. Actual conditions and features in the real world should not result in false warnings or false braking to the extent that they encourage the driver to switch the system off.

## Regulation No. XXX

### Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking System (AEBS)

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## 1. Scope

This Regulation applies to the approval of vehicles of Category M1 and N1 with regard to an on-board system to avoid or mitigate the severity of a rear-end in lane collision with a passenger car or to avoid or mitigate the severity of an impact with a vulnerable road user.

## 2. Definitions

For the purposes of this Regulation:

- 2.1. "Advanced Emergency Braking System (AEBS)" means a system which can automatically detect an **imminent potential** forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating a collision.
- 2.2. "Emergency Braking Phase" means ~~the phase starting when the AEBS emits~~ a braking demand **emitted by the AEBS** to the service braking system of the vehicle.
- 2.3. "Collision Warning Phase" means **a warning emitted by the phase directly preceding the emergency braking phase, during which the AEBS to warns the driver when the AEBS has detected** ~~of~~ a potential forward collision.
- 2.4. "Vehicle Type with Regard to its Advanced Emergency Braking System" means a category of vehicles which do not differ in such essential respects as:
  - (a) Vehicle features which significantly influence the performances of the Advanced Emergency Braking System;
  - (b) The type and design of the Advanced Emergency Braking System.
- 2.5. "Subject Vehicle" means the vehicle being tested.
- 2.9. "Soft Target" means a target that will suffer minimum damage and cause minimum damage to the subject vehicle in the event of a collision.
- 2.10. ~~"Moving Target" means a target travelling at a constant speed in the same direction and in the centre of the same lane of travel as the subject vehicle~~  
"Vehicle Target " means a target that represents a vehicle
- 2.10.1 "Pedestrian Target" means a soft target that represents a pedestrian
- 2.10.2 "Cyclist Target" means a soft target that represents a cyclist
- 2.11. ~~"Stationary Target" means a target at standstill facing the same direction and positioned on the centre of the same test lane of travel as the subject vehicle.~~
- 2.12. "Common Space" means an area on which two or more information functions (e.g. symbol) may be displayed, but not simultaneously.
- 2.13. "Self-Check" means an integrated function that checks for a system failure on a semi-continuous basis at least while the system is active.
- 2.14. "Time to Collision (TTC)" means the value of time obtained by dividing the distance between the subject vehicle and the target by the relative speed of the subject vehicle and the target, at an instant in time.

### **3. Application for approval**

- 3.1. The application for approval of a vehicle type with regard to the Advanced Emergency Braking System shall be submitted by the vehicle manufacturer or by his authorised representative.
- 3.2. It shall be accompanied by the documents mentioned below in triplicate:
  - 3.2.1. A description of the vehicle type with regard to the items mentioned in Paragraph 2.4., together with a documentation package which gives access to the basic design of the AEBS and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The numbers and/or symbols identifying the vehicle type shall be specified.
- 3.3. A vehicle representative of the vehicle type to be approved shall be submitted to the Technical Service conducting the approval tests.

### **4. Approval**

- 4.1. If the vehicle type submitted for approval pursuant to this Regulation meets the requirements of Paragraph 5. below, approval of that vehicle shall be granted.
- 4.2. An approval number shall be assigned to each type approved; its first two digits (at present 00 corresponding to the 00 series of amendments) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to the same vehicle type equipped with another type of AEBS, or to another vehicle type.
- 4.3. Notice of approval or of refusal or withdrawal of approval pursuant to this Regulation shall be communicated to the Parties to the Agreement which apply this Regulation by means of a form conforming to the model in Annex 1 and documentation supplied by the applicant being in a format not exceeding A4 (210 × 297mm), or folded to that format, and on an appropriate scale or electronic format.
- 4.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation, an international approval mark conforming to the model described in Annex 2, consisting of:
  - 4.4.1. A circle surrounding the Letter "E" followed by the distinguishing number of the country which has granted approval;<sup>1</sup>
  - 4.4.2. The number of this Regulation, followed by the Letter "R", a dash and the approval number to the right of the circle prescribed in Paragraph 4.4.1. above.
- 4.5. If the vehicle conforms to a vehicle type approved under one or more other Regulations, annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in Paragraph 4.4.1. above need not be repeated; in such a

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<sup>1</sup> The distinguishing numbers of the Contracting Parties to the 1958 Agreement are reproduced in Annex 3 to the Consolidated Resolution on the Construction of Vehicles (R.E.3), document ECE/TRANS/WP.29/78/Rev.3.

case, the Regulation and approval numbers and the additional symbols shall be placed in vertical columns to the right of the symbol prescribed in Paragraph 4.4.1. above.

- 4.6. The approval mark shall be clearly legible and be indelible.
- 4.7. The approval mark shall be placed close to or on the vehicle data plate.

## 5. Specifications

### 5.1. General

5.1.1. Any vehicle fitted with an AEBS complying with the definition of Paragraph 2.1. above shall meet the performance requirements contained in Paragraphs 5.1. to 5.6.2. of this Regulation and shall be equipped with an anti-lock braking function in accordance with the performance requirements of Annex 6 to Regulation No.13-H 01 Series of amendments for vehicles of Category M1 and N1 or of Annex 13 to Regulation No. 13 11 Series of amendments for vehicles Category N1.

5.1.2. The effectiveness of AEBS shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by fulfilling the technical requirements and respecting the transitional provisions of Regulation No. 10 ~~by applying~~ **05 series of amendments**.

- ~~(a) The 03 series of amendments for vehicles without a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries);~~
- ~~(b) The 04 series of amendments for vehicles with a coupling system for charging the Rechargeable Electric Energy Storage System (traction batteries).~~

5.1.3. Conformity with the safety aspects of ~~complex~~ electronic control systems shall be shown by meeting the requirements of Annex 3.

### 5.1.4. Warnings

**In addition to the collision warnings described in paragraphs 5.2.1.1., 5.2.2.1. and 5.2.3.1., the system shall provide the driver with appropriate warning(s) as below:**

5.1.4.1. **A failure warning when there is a failure in the AEBS that prevents the requirements of this Regulation of being met. The warning shall be as specified in Paragraph 5.5.4.**

5.1.4.1.1. **There shall not be an appreciable time interval between each AEBS self-check, and subsequently there shall not be an appreciable delay in illuminating the warning signal, in the case of an electrically detectable failure.**

5.1.4.2. **A deactivation warning, if the vehicle is equipped with a means to manually deactivate the AEBS, shall be given when the system is deactivated. This shall be as specified in Paragraph 5.4.2.**

### 5.1.5. Emergency braking

**Subject to the provisions of paragraph 5.3.1. and 5.3.2., the system shall provide emergency braking interventions described in paragraphs 5.2.1.2., 5.2.2.2. and 5.2.3.2. having the purpose of significantly decreasing the speed of the subject vehicle.**

### 5.1.5. False reaction avoidance

The system shall be designed to minimise the generation of collision warning signals and to avoid autonomous braking in situations where the driver would not recognise an impending [forward or crossing] collision. This shall be demonstrated in accordance with Paragraph 6.11. of this Regulation.

5.2. Performance Requirements

5.2.1. Car to car scenario

5.2.1.1. **Collision** warnings

The system shall provide the driver with appropriate warning(s) as below:

~~5.2.1.1.1. A collision warning when the vehicle speed is above [XX] km/h and the AEBS has detected the possibility of a collision with a preceding vehicle of Category M1 in the same lane. The warning shall be as specified in Paragraph 5.5.1.~~

**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, the collision warning shall be 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 seconds ahead of an emergency braking, the collision warning shall be issued immediately after the detection.**

~~5.2.1.1.2. A failure warning when there is a failure in the AEBS that prevents the requirements of this Regulation of being met. The warning shall be as specified in Paragraph 5.5.4. below.~~

~~5.2.1.1.2.1. There shall not be an appreciable time interval between each AEBS self check, and subsequently there shall not be an appreciable delay in illuminating the warning signal, in the case of an electrically detectable failure.~~

~~5.2.1.1.3. A deactivation warning, if the vehicle is equipped with a means to manually deactivate the AEBS, shall be given when the system is deactivated. This shall be as specified in Paragraph 5.4.2. below.~~

5.2.1.2. Emergency braking phase

**Subsequent to the warning(s) of Paragraph 5.2.1.1.1. above, and subject to the provisions of Paragraphs 5.3.1. and 5.3.2. below When the system has detected the possibility of an imminent collision, there shall be an emergency braking intervention phase having the purpose of significantly decreasing the speed of the subject vehicle emitting an average braking demand of at least [3.8 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup> or fully cycling ABS,] to the service braking system of the vehicle.**

This shall be tested in accordance with Paragraphs 6.4. and 6.5., 6.6., 6.7. and 6.8. of this Regulation.

~~5.2.1.2.1. In an emergency braking phase, the AEBS shall emit an average braking demand for at least [3.8 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup>,] to the service braking system of the vehicle~~

5.2.1.3. Speed range

The system shall be active at least within the vehicle speed range between 10 km/h and ~~{50/60}~~ 60 km/h and at all vehicle load conditions, unless manually deactivated as per Paragraph 5.4. below.

~~5.2.1.4. Collision warning avoidance~~

~~The system shall be designed to minimise the generation of collision warning signals and to avoid autonomous braking in situations where the driver would not recognise an impending {forward or crossing} collision. This shall be demonstrated in accordance with Paragraph 6.11. of this Regulation.~~

**5.2.1.4. Speed reduction by braking demand Last point to brake**

When the system is activated and the conditions described in paragraphs 6.1. to 6.2. are fulfilled, the system shall emit the braking demand specified in paragraph 5.2.1.2. at the latest [LPS] s or [LPB] s, whichever is the latest, before the impact shall result in a speed reduction and impact speed according to the table below.

| Relative Test Speed (km/h) | Speed Reduction (km/h) | Impact Speed (km/h) |
|----------------------------|------------------------|---------------------|
| 10                         | 10,00                  | 0,00                |
| 15                         | 15,00                  | 0,00                |
| 20                         | 20,00                  | 0,00                |
| 25                         | 25,00                  | 0,00                |
| 30                         | 30,00                  | 0,00                |
| 35                         | 35,00                  | 0,00                |
| 40                         | 40,00                  | 0,00                |
| 42                         | 42,00                  | 0,00                |
| 45                         | 30,00                  | 15,00               |
| 50                         | 25,00                  | 25,00               |
| 55                         | 25,00                  | 30,00               |
| 60                         | 25,00                  | 35,00               |

[In the case of the approval of vehicle types of Category N1 already approved to UN Regulation No. 13 / APPROPRIATE TECHNICAL CRITRIA TBD, the required speed reduction in the table above shall be decreased by XX km/h].

The speed reduction shall be demonstrated according to paragraphs 6.4. and 6.5.

5.2.2. Car to pedestrian scenario

5.2.2.1. Collision warnings

~~The system shall provide the driver with appropriate warning(s) as below:~~

~~5.2.2.1.1. A collision warning when the vehicle speed is above [XX] km/h and the~~ **When the AEBS has detected the possibility of a collision with a preceding vehicle of Category M1 in the same lane pedestrian crossing the road at a constant speed of 5 km/h, the 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.

~~5.2.2.1.2. A failure warning when there is a failure in the AEBS that prevents the requirements of this Regulation of being met. The warning shall be as specified in Paragraph 5.5.4. below.~~

~~5.2.2.1.2.1. There shall not be an appreciable time interval between each AEBS self check, and subsequently there shall not be an appreciable delay in illuminating the warning signal, in the case of an electrically detectable failure.~~

~~5.2.2.1.3. A deactivation warning, if the vehicle is equipped with a means to manually deactivate the AEBS, shall be given when the system is deactivated. This shall be as specified in Paragraph 5.4.2. below.~~

5.2.2.2. Emergency braking phase

Subsequent to the warning(s) of Paragraph 5.2.1.1.1. above, and subject to the provisions of Paragraphs 5.3.1. and 5.3.2. below **When the system has detected the possibility of an imminent collision**, there shall be an emergency braking intervention phase having the purpose of significantly decreasing the speed of the subject vehicle **emitting an average braking demand of at least [3.8 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup> or fully cycling ABS,]** to the service braking system of the vehicle.

This shall be tested in accordance with Paragraph 6.4., 6.5., ~~6.6.~~, 6.7. and 6.8. of this Regulation.

~~5.2.2.2.1. In an emergency braking phase, the AEBS shall emit an average braking demand for at least [3.7 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup>,] to the service braking system of the vehicle.~~

5.2.2.3. Speed range

The system shall be active at least within the vehicle speed range between ~~40~~ **[20]** km/h and ~~{50/60}~~ **60** km/h and at all vehicle load conditions, unless manually deactivated as per Paragraph 5.4. below.

~~5.2.2.4. Collision warning avoidance~~

~~The system shall be designed to minimise the generation of collision warning signals and to avoid autonomous braking in situations where the driver would not recognise an impending [forward or crossing] collision. This shall be demonstrated in accordance with Paragraph 6.11. of this Regulation.~~

5.2.2.5. Speed reduction by braking demand ~~Last point to brake~~

**When the system is activated and the conditions described in paragraphs 6.1. to 6.2. are fulfilled**, the system shall emit the braking demand specified in paragraph 5.2.2.2. ~~at the latest [LPS] s or [LPB] s, whichever is the latest, before the impact shall result in a speed reduction and impact speed according to the table below:~~

1<sup>st</sup> step (EIF i.e. ca 2020 in UNECE)

| Relative Test Speed [km/h] | Speed Reduction [km/h] | Impact Speed [km/h] |
|----------------------------|------------------------|---------------------|
| 10                         | TBD                    | TBD                 |
| 15                         | TBD                    | TBD                 |
| 20                         | 20,00                  | 0,00                |
| 25                         | 25,00                  | 0,00                |
| 30                         | 30,00                  | 0,00                |
| 35                         | TBD                    | TBD                 |
| 40                         | TBD                    | TBD                 |
| 42                         | TBD                    | TBD                 |
| 45                         | TBD                    | TBD                 |
| 50                         | TBD                    | TBD                 |
| 55                         | TBD                    | TBD                 |
| 60                         | TBD                    | TBD                 |

[In the case of the approval of vehicle types of Category N1 already approved to UN Regulation No. 13 / APPROPRIATE TECHNICAL CRITERIA TBD, the required speed reduction in the table above shall be decreased by XX km/h].

2<sup>nd</sup> step (2023 in UNECE – i.e. 2023 in EU)

| Relative Test Speed [km/h] | Speed Reduction [km/h] | Impact Speed [km/h] |
|----------------------------|------------------------|---------------------|
| 10                         | TBD                    | TBD                 |
| 15                         | TBD                    | TBD                 |
| 20                         | 20,00                  | 0,00                |
| 25                         | 25,00                  | 0,00                |
| 30                         | 30,00                  | 0,00                |
| 35                         | 35,00                  | 0,00                |
| 40                         | 40,00                  | 0,00                |
| 42                         | 42,00                  | 0,00                |
| 45                         | TBD                    | TBD                 |
| 50                         | TBD                    | TBD                 |
| 55                         | TBD                    | TBD                 |
| 60                         | TBD                    | TBD                 |

[In the case of the approval of vehicle types of Category N1 already approved to UN Regulation No. 13 / APPROPRIATE TECHNICAL CRITERIA TBD, the required speed reduction in the table above shall be decreased by XX km/h].

The speed reduction shall be demonstrated according to paragraph 6.6.

5.2.3. Car to bicycle scenario

5.2.3.1. **Collision warnings**

The system shall provide the driver with appropriate warning(s) as below:

- 5.2.3.1.1. ~~A collision warning when the vehicle speed is above [XX] km/h and the AEBS has detected the possibility of a collision with a preceding vehicle of Category M1 in the same lane. The warning shall be as specified in Paragraph 5.5.1.~~

**When the AEBS has detected the possibility of a collision with a cyclist crossing the road at a constant speed of [15 km/h], 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.**

- 5.2.3.1.2. ~~A failure warning when there is a failure in the AEBS that prevents the requirements of this Regulation of being met. The warning shall be as specified in Paragraph 5.5.4. below.~~

**When a collision with a preceding bicycle, in the same lane with a relative speed above that speed up to which the vehicle is able to avoid the collision, can be anticipated 0,8 s ahead of an emergency braking phase, the collision warning shall be 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 seconds ahead of an emergency braking, the collision warning shall be issued immediately after the detection.**

- ~~5.2.3.1.2.1. There shall not be an appreciable time interval between each AEBS self check, and subsequently there shall not be an appreciable delay in illuminating the warning signal, in the case of an electrically detectable failure.~~

- ~~5.2.3.1.3. A deactivation warning, if the vehicle is equipped with a means to manually deactivate the AEBS, shall be given when the system is deactivated. This shall be as specified in Paragraph 5.4.2..~~

5.2.3.2. **Emergency braking phase**

~~Subsequent to the warning(s) of Paragraph 5.2.1.1.1. above, and subject to the provisions of Paragraphs 5.3.1. and 5.3.2. below~~ **When the system has detected the possibility of an imminent collision, there shall be an emergency braking intervention phase having the purpose of significantly decreasing the speed of the subject vehicle emitting an average braking demand of at least [3.8 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup> or fully cycling ABS,] to the service braking system of the vehicle.**

~~This shall be tested in accordance with Paragraph 6.4., 6.5., 6.6., 6.7. and 6.8. of this Regulation.~~

- ~~5.2.3.2.1. In an emergency braking phase, the AEBS shall emit an average braking demand for at least [3.7 m/s<sup>2</sup> deceleration, with at least a peak at 6,43 m/s<sup>2</sup>,] to the service braking system of the vehicle.~~

5.2.3.3. **Speed range**

The system shall be active at least within the vehicle speed range between 10 km/h and {50/60} [30 km/h] and at all vehicle load conditions, unless manually deactivated as per Paragraph 5.4. below.

~~5.2.3.4. Collision warning avoidance~~

~~The system shall be designed to minimise the generation of collision warning signals and to avoid autonomous braking in situations where the driver would not recognise an impending [forward or crossing] collision. This shall be demonstrated in accordance with Paragraph 6.11. of this Regulation.~~

**5.2.3.5. Speed reduction by braking demand Last point to brake**

When the system is activated and the conditions described in paragraphs 6.1. to 6.2. are fulfilled, the system shall emit the braking demand specified in paragraph 5.2.3.2. at the latest [LPS] s or [LPB] s, whichever is the latest, before the impact shall result in a speed reduction and impact speed according to the table below.

| Test Speed [km/h] | Speed Reduction (Crossing scenario – paragraph 5.2.3.1.1.) | Speed Reduction (Longitudinal scenario – paragraph 5.2.3.1.2.) |
|-------------------|--|--|
| TBD               | TBD  | TBD  |

[In the case of the approval of vehicle types of Category N1 already approved to UN Regulation No. 13 / APPROPRIATE TECHNICAL CRITERIA TBD, the required speed reduction in the table above shall be decreased by XX km/h].

The speed reduction shall be demonstrated according to paragraph 6.7.

**5.3. Interruption by the Driver**

5.3.1. The AEBS shall provide the means for the driver to interrupt the collision warning phase and the emergency braking phase.

5.3.2. In both cases above, this interruption may be initiated by any positive action (e.g. kick-down, 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 to the technical service at the time of type approval and it shall be annexed to the test report.

**5.4. Manual deactivation**

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

5.4.1. The AEBS function shall be automatically reinstated at the initiation of each new ignition cycle.

5.4.2. 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.

5.4.3. The AEBS control shall be installed so as to comply with the relevant requirements and transitional provisions of UN Regulation No. 121, 01 series of amendments or any later series of amendments.

5.4.4. The AEBS control shall be designed in such a way that its operation shall not be possible with less than two deliberate actions.

5.4.5. It shall not be possible to deactivate the AEBS at a speed above 10 km/h.

## 5.5. Warning Indication

5.5.1. The collision warning referred to in Paragraphs ~~5.2.1.1.~~ 5.2.1.1., 5.2.2.1., 5.2.3.1.1. and 5.2.3.1.2. ~~above~~ shall be provided by at least two modes selected from acoustic, haptic or optical.

~~The timing of the warning signals shall be such that they provide the possibility for the driver to react to the risk of collision and take control of the situation, and shall also avoid nuisance for the driver by too early or too frequent warnings. This shall be tested in accordance with the provisions of Paragraphs 6.4.2., 6.5.2., 6.6.2, 6.7.2. and 6.8.2. of this Regulation.~~

5.5.2. A description of the warning indication and the sequence in which the collision warning signals are presented to the driver shall be provided by the vehicle manufacturer at the time of type-approval and recorded in the test report.

5.5.3. Where an optical means is used as part of the collision warning, the optical signal may be the flashing of the failure warning signal specified in Paragraph 5.5.4. ~~below~~.

5.5.4. The failure warning referred to in Paragraph ~~5.2.1.2.~~ 5.1.4.1. ~~above~~ shall be a constant yellow optical warning signal.

5.5.5. Each AEBS optical warning signal shall be activated either when the ignition (start) switch is turned to the "on" (run) position or when the ignition (start) switch is in a position between the "on" (run) and "start" that is designated by the manufacturer as a check position (initial system (power-on)). This requirement does not apply to warning signals shown in a common space.

5.5.6. The optical warning signals shall be visible even by daylight; the satisfactory condition of the signals must be easily verifiable by the driver from the driver's seat.

5.5.7. When the driver is provided with an optical warning signal to indicate that the AEBS is temporarily not available, for example due to inclement weather conditions, the signal shall be constant and yellow in colour. The failure warning signal specified in Paragraph 5.5.4. above may be used for this purpose.

## 5.6. Provisions for the Periodic Technical Inspection

5.6.1. At a periodic technical inspection it shall be possible to confirm the correct operational status of the AEBS by a visible observation of the failure warning signal status, following a "power-ON" and any bulb check.

In the case of the failure warning signal being in a common space, the common space must be observed to be functional prior to the failure warning signal status check.

5.6.2. At the time of type approval, the means to protect against simple unauthorised modification of the operation of the failure warning signal chosen by the manufacturer shall be confidentially outlined.

Alternatively, this protection requirement is fulfilled when a secondary means of checking the correct operational status of the AEBS is available.

## **[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.
- 6.1.2. The ambient temperature shall be between 0°C and 45°C.
- 6.1.3. The horizontal visibility range shall allow the target to be observed throughout the test.
- 6.1.4. The tests shall be performed when there is no wind liable to affect the results.
- 6.1.5. Natural ambient illumination must be homogeneous in the test area and in excess of [2000] lux with no strong shadows cast across the subject vehicles path when conducting the test. It should be ensured that testing is not performed whilst driving towards, or away from the sun at a low angle.**

### **6.2. Vehicle Conditions**

#### **6.2.1. Test Weight**

~~The vehicle shall be tested in a condition of load to be agreed between the manufacturer and the Technical Service.~~ **The vehicle shall be tested with the fuel tank filled up with fuel to at least 90% of the tank's capacity of fuel, plus 200 kg including the occupants and the test equipment. The load distribution shall be according to the manufacturer's recommendation.** No alteration shall be made once the test procedure has begun.

#### **6.2.2. Pre Test Conditioning**

##### **6.2.2.1. If requested by the vehicle manufacturer,**

- a) **The vehicle can be driven a maximum of 100 km on a mixture of urban and rural roads with other traffic and roadside furniture to calibrate the sensor system.**
- b) **The vehicle can undergo a sequence of brake activations in order to ensure the service brake system is bedded in prior to the test.**

##### **6.2.2.2. Details of the pre-test condition strategy requested by the vehicle manufacturer shall be identified and recorded in the vehicle type approval documentation.**

### **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. <sup>2</sup>

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<sup>2</sup> The identification characteristics of the soft target shall be agreed upon between the Technical Service and the vehicle manufacturer as being equivalent to a passenger car of Category M1 AA saloon.

- 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.<sup>3</sup>
- 6.3.3. The targets used for the bicycle detection tests shall be a “soft target” and be representative of the human and bicycle attributes applicable to the sensor system of the AEBS under test.<sup>4</sup>
- 6.3.4. Details that enable the target(s) to be specifically identified and reproduced shall be recorded in the vehicle type approval documentation.

**6.4. Warning and Activation Test with a Stationary Vehicle Target**

- 6.4.1. 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 0.5m.

**Tests shall be conducted with a vehicle travelling at 20, 42 and 60 km/h. If this is deemed justified, the technical service may test any other speeds within the speed range as defined in paragraph 5.2.1.3.**

The functional part of the test shall start when the subject vehicle is travelling at a constant speed as defined in Table I, Column B of Annex 3 and is at a distance of at least 50m from the target and is at a distance corresponding to a 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.

- 6.4.2. The timing for the collision warning modes referred to in Paragraph 5.5.1. above shall comply with the provisions of paragraph 5.2.1.1. following:
- ~~6.4.2.1. At least an optical warning and either an acoustic or haptic warning shall be provided no later than specified in Table I, Column C, of Annex 3.~~
- ~~6.4.3. The warning phase shall be followed by the emergency braking phase.~~
- ~~6.4.4. The total speed reduction of the subject vehicle at the time of the impact with the stationary target shall be not less than the value specified in Table I, Column F of Annex 3.~~
- ~~6.4.5. The emergency braking phase shall start no later than a TTC equal to or less than the value specified in Table I, Column D of Annex 3.~~
- ~~6.4.6. The emergency braking phase shall not start before a TTC equal to or less than the value specified in Table I, Column E of Annex 3.~~

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<sup>3</sup> The identification characteristics of the soft target shall be agreed upon between the Technical Service and the vehicle manufacturer as being equivalent to an adult or child pedestrian.

<sup>4</sup> The identification characteristics of the soft target shall be agreed upon between the Technical Service and the vehicle manufacturer as being equivalent to a **bicycle and** a cyclist.

~~6.4.7. Compliance to 6.4.5 and 6.4.6. shall be verified by either actual measurement during the test or using documentation provided by the vehicle manufacturer, as agreed between the Technical Service and the vehicle manufacturer.~~

## **6.5. Warning and Activation Test with a Moving Vehicle Target**

6.5.1. The subject vehicle and the moving target shall travel in a straight line, in the same direction, 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 0.5m.

**Tests shall be conducted with a vehicle travelling at 30, 40 and 62 km/h and target travelling at 20 km/h. If this is deemed justified, the technical service may test any other speeds within the speed range as defined in paragraph 5.2.1.3.**

The functional part of the test shall start when the subject vehicle is travelling at a constant speed as defined in Table I, Column B of Annex 3 and is at a distance of at least 50m from the target and is at a distance corresponding to a TTC of at least 4 seconds from the target.

From the start of the functional part of the test until the subject vehicle comes to a speed equal to that of the target there shall be no adjustment to any subject vehicle control by the driver other than slight steering adjustments to counteract any drifting.

6.5.2. The timing for the collision warning modes referred to in Paragraph 5.5.1. above shall comply with the **provisions of paragraph 5.2.1.1. following:**

~~6.5.2.1. At least an optical warning and either an acoustic or haptic warning shall be provided no later than specified in Table II, Column C of Annex 3~~

6.5.3. The warning phase shall be followed by the emergency braking phase.

~~6.5.4. The total speed reduction of the subject vehicle at the time of the impact with the target vehicle shall be not less than the value specified in Table II, Column F of Annex 3.~~

~~6.5.5. The emergency braking phase shall start no later than a TTC equal to or less than the value specified in Table II, Column D of Annex 3.~~

~~6.5.6. The emergency braking phase shall not start before a TTC equal to or less than the value specified in Table II, Column E of Annex 3.~~

~~6.5.7. Compliance to 6.5.5 and 6.5.6. shall be verified by either actual measurement during the test or using documentation provided by the vehicle manufacturer, as agreed between the Technical Service and the vehicle manufacturer.~~

## **6.6. Warning and Activation Test with a Pedestrian Target**

*{Outcome of AEBS 03: EuroNCAP/J-NCAP for the time being as it is the only one available}*

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 a subject vehicle to impact point centreline offset of not more than **[0.5]** m.

The pedestrian target shall travel in a straight line perpendicular to the subject vehicle's direction of travel at a **constant speed of 5 km/h** defined in Table IV, Column G of Annex 3. The pedestrian target's positioning shall be coordinated with the subject vehicle in such a



way that the impact point of the pedestrian target on **the front of** the subject vehicle is **on** the **longitudinal** centreline of the subject vehicle if the subject vehicle remains at the prescribed test speed throughout the functional part of the test and does not brake.

The functional part of the test shall start when the subject vehicle is travelling at a constant speed between 10 km/h and ~~{50/60}~~ **30 km/h as defined in Table IV, Column B of Annex 3** and is at a distance of at least 50 m from the target.

From the start of the functional part until the subject vehicle has avoided the collision or the subject vehicle has passed the impact point with the pedestrian target 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.

The test prescribed above shall be carried out with both an adult and child pedestrian “soft target” defined in **6.3.2**.

6.6.2. The timing for the collision warning modes referred to in Paragraph **5.5.1**. above shall comply with the **provisions of paragraph 5.2.2.1.1.** following:

~~6.7.2.1. At least an optical warning and either an acoustic or haptic warning shall be provided no later than specified in Table IV, Column C of Annex 3.~~

~~6.7.3. The warning phase shall be followed by the emergency braking phase.~~

~~6.7.4. The total speed reduction of the subject vehicle at the time of the impact with the pedestrian target shall be not less than the value specified in Table IV, Column F of Annex 3.~~

~~6.7.5. The emergency braking phase shall start no later than a TTC equal to or less than the value specified in Table IV, Column D of Annex 3.~~

~~6.7.6. The emergency braking phase shall not start before a TTC equal to or less than the value specified in Table IV, Column E of Annex 3.~~

~~6.7.7. Compliance to ~~6.7.5~~ and ~~6.7.6~~ shall be verified by either actual measurement during the test or using documentation provided by the vehicle manufacturer, as agreed between the Technical Service and the vehicle manufacturer.~~

## **6.7. Warning and Activation Test with a Bicycle Target**

### **6.7.1. Crossing scenario**

**6.7.1.1.** The subject vehicle shall approach the impact point with the bicycle target in a straight line for at least two seconds prior to the functional part of the test with a subject vehicle to impact point centreline offset of not more than **[0.5]** m.

The bicycle target shall travel in a straight line perpendicular to the subject vehicle’s direction of travel at a **constant speed of 15 km/h defined in Table V, Column G of Annex 3**. The bicycle target’s positioning shall be coordinated with the subject vehicle in such a way that the impact point of the bicycle target on the subject vehicle is the **longitudinal** centreline of **the front of** the subject vehicle if the subject vehicle remains at the prescribed test speed throughout the functional part of the test and does not brake.

The functional part of the test shall start when the subject vehicle is travelling at a constant speed between **10 km/h and ~~{50/60}~~ 20 km/h as defined in Table V, Column B of Annex 3** and is at a distance of at least 50m from the target.

From the start of the functional part until the subject vehicle has avoided the collision or the subject vehicle has passed the impact point with the bicycle target 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.

6.7.1.2. The timing for the collision warning modes referred to in Paragraph 5.5.1. above shall comply with the provisions of paragraph 5.2.3.1.1. following:

6.7.2. **Longitudinal scenario**

6.7.2.1. **The subject vehicle and the moving target shall travel in a straight line, in the same direction, 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 0.5m.**

Tests shall be conducted with a subject vehicle travelling at [XX] km/h and target travelling at 20 km/h. If this is deemed justified, the technical service may test any other speeds within the speed range as defined in paragraph 5.2.1.3.

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 target.

From the start of the functional part of the test until the subject vehicle comes to a speed equal to that of the target there shall be no adjustment to any subject vehicle control by the driver other than slight steering adjustments to counteract any drifting.

6.7.2.2. The timing for the collision warning modes referred to in Paragraph 5.5.1. above shall comply with the provisions of paragraph 5.2.3.1.2.

~~6.8.2.1. At least an optical warning and either an acoustic or haptic warning shall be provided no later than specified in Table V, Column C of Annex 3.~~

~~6.8.2.3. Any speed reduction during the warning phase, shall not exceed either [15]km/h or [30]% of the total subject vehicle speed reduction, whichever is higher.~~

6.3.3. The warning phase shall be followed by the emergency braking phase.

6.7.4. The total speed reduction of the subject vehicle at the time of the impact with the bicycle target shall be not less than the value specified in Paragraphs 5.2.3.1.1 and 5.2.3.1.2 respectively. Table V, Column F of Annex 3.

~~6.8.5. The emergency braking phase shall start no later than a TTC equal to or less than the value specified in Table V, Column D of Annex 3.~~

~~6.8.6. The emergency braking phase shall not start before a TTC equal to or less than the value specified in Table V, Column E of Annex 3.~~

~~6.8.6. Compliance to 6.8.5 and 6.8.6. shall be verified by either actual measurement during the test or using documentation provided by the vehicle manufacturer, as agreed between the Technical Service and the vehicle manufacturer.~~

6.8. **Failure Detection Test**

6.8.1 Simulate an electrical failure, for example by disconnecting the power source to any AEBS component or disconnecting any electrical connection between AEBS components. When simulating an AEBS failure, neither the electrical connections for the driver warning signal of Paragraph 5.5.4. above nor the optional manual AEBS deactivation control of Paragraph 5.4. shall be disconnected.

6.8.2. The failure warning signal mentioned in Paragraph 5.5.4. above shall be activated and remain activated not later than 10s after the vehicle has been driven at a speed greater than 10 km/h and be reactivated immediately after a subsequent ignition "off" ignition "on" cycle with the vehicle stationary as long as the simulated failure exists.

## 6.9. Deactivation Test

6.9.1. For vehicles equipped with means to deactivate the AEBS, turn the ignition (start) switch to the "on" (run) position and deactivate the AEBS. The warning signal mentioned in Paragraph 5.4.2. above shall be activated. Turn the ignition (start) switch to the "off" position. Again, turn the ignition (start) switch to the "on" (run) position and verify that the previously activated warning signal is not reactivated, thereby indicating that the AEBS has been reinstated as specified in Paragraph 5.4.1. above. If the ignition system is activated by means of a "key", the above requirement shall be fulfilled without removing the key.

## 6.10. False Reaction Avoidance Test

### 6.10.1 Vehicle Target

6.10.1.1. Two stationary vehicles, of Category M1 AA saloon, shall be positioned:

- (a) So as to face in the same direction of travel as the subject vehicle,
- (b) With a distance of 4.5m between them(1),
- (c) With the rear of each vehicle aligned with the other.

6.10.1.2. The subject vehicle shall travel for a distance of at least [60] m, at a constant speed of  $50 \pm 2$  km/h to pass centrally between the two stationary vehicles.

During the test there shall be no adjustment of any subject vehicle control other than slight steering adjustments to counteract any drifting.

6.10.1.3. The AEBS shall not provide a collision warning and shall not initiate the emergency braking phase.

### 6.10.2 Pedestrian Target

6.10.2.1. A pedestrian target as prescribed in 6.3.2., shall be positioned:

- (a) So as to face in the **same direction of travel as** ~~direction perpendicular to that of the~~ subject vehicle,
- (b) With a distance of ~~[2]~~ **1** m from the subject vehicle **side closest to the target centreline toward the side in the direction of traffic,**

6.10.2.2. The subject vehicle shall travel in a straight line for a distance of at least ~~[50]~~ **60** m, at a constant speed of  $[XX \pm YY]$  km/h to pass the stationary pedestrian target.

During the test there shall be no adjustment of any subject vehicle control other than slight steering adjustments to counteract any drifting.

6.10.2.3. The AEBS shall not provide a collision warning and shall not initiate the emergency braking phase.

### **6.10.3. Bicycle Target**

6.10.3.1. A bicycle target as prescribed in 6.3.3., shall be positioned:

- (a) So as to face in the **same direction of travel as** ~~direction perpendicular to that of the~~ subject vehicle,
- (b) With a distance of ~~{2}~~ **1 m** from the subject vehicle **side closest to the target centreline toward the side in the direction of traffic**,

6.10.3.2. The subject vehicle shall travel in a straight line for a distance of at least ~~{50}~~ **60 m**, at a constant speed of [XX ± YY] km/h to pass the stationary bicycle target.

During the test there shall be no adjustment of any subject vehicle control other than slight steering adjustments to counteract any drifting.

6.10.3.3. The AEBS shall not provide a collision warning and shall not initiate the emergency braking phase. ]

## **7. Modification of vehicle type and extension of approval**

7.1. Every modification of the vehicle type as defined in Paragraph 2.2. above shall be notified to the Type Approval Authority which approved the vehicle type. The Type Approval Authority may then either:

7.1.1. Consider that the modifications made do not have an adverse effect on the conditions of the granting of the approval and grant an extension of approval;

7.1.2. Consider that the modifications made affect the conditions of the granting of the approval and require further tests or additional checks before granting an extension of approval.

7.2. Confirmation or refusal of approval, specifying the alterations, shall be communicated by the procedure specified in Paragraph 4.3. above to the Contracting Parties to the Agreement which apply this Regulation.

7.3. The Type Approval Authority shall inform the other Contracting Parties of the extension by means of the communication form which appears in Annex 1 to this Regulation. It shall assign a serial number to each extension, to be known as the extension number.

## **8. Conformity of production**

8.1. Procedures concerning conformity of production shall conform to the general provisions defined in Appendix 2 to the Agreement (E/ECE/324-E/ECE/TRANS/505/Rev.3) and meet the following requirements:

8.2. A vehicle approved pursuant to this Regulation shall be so manufactured as to conform to the type approved by meeting the requirements of Paragraph 5. above;

- 8.3. The Type Approval Authority which has granted approval may at any time verify the conformity of control methods applicable to each production unit. The normal frequency of such inspections shall be once every two years.

## **9. Penalties for non-conformity of production**

- 9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in Paragraph 8. above are not complied with.
- 9.2. If a Contracting Party withdraws an approval it had previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation by sending them a communication form conforming to the model in Annex 1 to this Regulation.

## **10. Production definitively discontinued**

If the holder of the approval completely ceases to manufacture a type of vehicle approved in accordance with this Regulation, he shall so inform the Type Approval Authority which granted the approval, which in turn shall forthwith inform the other Contracting Parties to the Agreement applying this Regulation by means of a communication form conforming to the model in Annex 1 to this Regulation.

## **11. Names and addresses of the Technical Services responsible for conducting approval tests and of Type Approval Authorities**

The Contracting Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the Technical Services responsible for conducting approval tests and of the Type Approval Authorities which grant approval and to which forms certifying approval or extension or refusal or withdrawal of approval are to be sent.

## Annex 1

### Communication

(Maximum format: A4 (210 x 297 mm))



issued by :

(Name of administration)

.....  
.....  
.....

Concerning: <sup>2</sup> Approval granted  
Approval extended  
Approval refused  
Approval withdrawn  
Production definitively discontinued

of a type of vehicle with regard to the advanced emergency braking system pursuant to Regulation No. XXX

Approval No.: ..... Extension No.: .....

1. Trademark: .....
2. Type and trade name(s): .....
3. Name and address of manufacturer: .....
4. If applicable, name and address of manufacturer's representative: .....
5. Brief description of vehicle: .....
6. Date of submission of vehicle for approval: .....
7. Technical Service performing the approval tests: .....
8. Date of report issued by that Service: .....
9. Number of report issued by that Service: .....
10. Approval granted/refused/extended/withdrawn:<sup>2</sup> .....
11. Place: .....
12. Date: .....
13. Signature: .....

<sup>1</sup> Distinguishing number of the country which has granted/extended/refused/withdrawn an approval (see approval provisions in the Regulation).

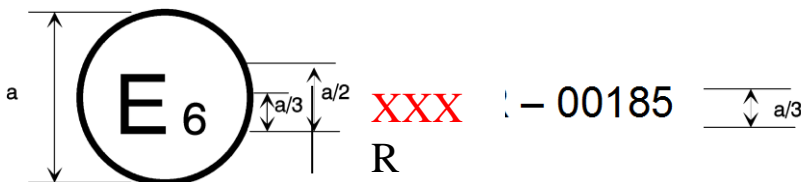
<sup>2</sup> Strike out what does not apply.

14. Annexed to this communication are the following documents, bearing the approval number indicated above: .....
15. Any remarks:.....

## Annex 2

### Arrangements of approval marks

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



$a = 8 \text{ mm min}$

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in Belgium (E 6) with regard to to the Advanced Emergency Braking Systems (AEBS) pursuant to Regulation No. **XXX**. The first two digits of the approval number indicate that the approval was granted in accordance with the requirements of Regulation No. **XXX** in its original form.



## Annex 3

### Special requirements to be applied to the safety aspects of complex electronic vehicle control systems

#### 1. GENERAL

This annex defines the special requirements for documentation, fault strategy and verification with respect to the safety aspects of Complex Electronic Vehicle Control Systems (paragraph 2.3. below) as far as this Regulation is concerned.

This annex may also be called, by special paragraphs in this Regulation, for safety related functions which are controlled by electronic system(s).

This annex does not specify the performance criteria for "The System" but covers the methodology applied to the design process and the information which must be disclosed to the technical service, for type approval purposes.

This information shall show that "The System" respects, under normal and fault conditions, all the appropriate performance requirements specified elsewhere in this Regulation.

The applicant (e.g. the manufacturer) may provide evidence that an Auxiliary Steering Equipment (ASE) (if fitted) has previously been assessed as part of an approval in accordance with the requirements of Annex 4 of this UN Regulation (as required under the original version of this UN Regulation, its 01 or its 02 series of amendments). In this case, the requirements of this Annex shall not be applied to that ASE for the purposes of an approval in accordance with the 03 series of amendments

#### 2. DEFINITIONS

For the purposes of this annex,

- 2.1. "*The System*" means an electronic control system or complex electronic control system that provides or forms part of the control transmission of a function to which this UN Regulation applies. This also includes any other system covered in the scope of this UN Regulation, as well as transmission links to or from other systems that are outside the scope of this UN Regulation, that acts on a function to which this UN Regulation applies.
- 2.2. "Safety Concept" is a description of the measures designed into the system, for example within the electronic units, so as to address system integrity and thereby ensure safe operation under fault and non-fault conditions, including in the event of an electrical failure. The possibility of a fall-back to partial operation or even to a back-up system for vital vehicle functions may be a part of the safety concept."
- "2.3. "Electronic Control System" means a combination of units, designed to co-operate in the production of the stated vehicle control function by electronic data processing. Such systems, often controlled by software, are built from discrete functional components such as sensors, electronic control units and actuators and connected by transmission links. They may include mechanical, electro-pneumatic or electro-hydraulic elements."

- "2.4. "Complex Electronic Vehicle Control Systems" are those electronic control systems in which a function controlled by an electronic system or the driver may be over-ridden by a higher level electronic control system/function. A function which is over-ridden becomes part of the complex system, as well as any overriding system/function within the scope of this UN Regulation. The transmission links to and from overriding systems/function outside of the scope of this UN Regulation shall also be included."
- "2.5. "Higher-Level Electronic Control" systems/functions are those which employ additional processing and/or sensing provisions to modify vehicle behaviour by commanding variations in the function(s) of the vehicle control system. This allows complex systems to automatically change their objectives with a priority which depends on the sensed circumstances..
- 2.6. "Units" are the smallest divisions of system components which will be considered in this annex, since these combinations of components will be treated as single entities for purposes of identification, analysis or replacement.
- 2.7. "Transmission links" are the means used for inter-connecting distributed units for the purpose of conveying signals, operating data or an energy supply. This equipment is generally electrical but may, in some part, be mechanical, pneumatic or hydraulic.
- 2.8. "Range of control" refers to an output variable and defines the range over which the system is likely to exercise control.
- 2.9. "Boundary of functional operation" defines the boundaries of the external physical limits within which the system is able to maintain control.
- 2.10. "*Safety Related Function*" means a function of "The System" that is capable of changing the dynamic behaviour of the vehicle. "The System" may be capable of performing more than one safety related function.

### 3. DOCUMENTATION

#### 3.1. Requirements

The manufacturer shall provide a documentation package which gives access to the basic design of "The System" and the means by which it is linked to other vehicle systems or by which it directly controls output variables. The function(s) of "The System" and the safety concept, as laid down by the manufacturer, shall be explained. Documentation shall be brief, yet provide evidence that the design and development has had the benefit of expertise from all the system fields which are involved. For periodic technical inspections, the documentation shall describe how the current operational status of "The System" can be checked.

The Technical Service shall assess the documentation package to show that "The System":

- a) Is designed to operate, under non-fault and fault conditions, in such a way that it does not induce safety critical risks;
- b) Respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this UN Regulation; and,
- c) Was developed according to the development process/method declared by the manufacturer.

#### 3.1.1. Documentation shall be made available in two parts:

- a) The formal documentation package for the approval, containing the material listed in paragraph 3. (with the exception of that of paragraph 3.4.4.) which shall be supplied to the Technical Service at the time of submission of the type approval application. This documentation package shall be used by the Technical Service as the basic reference for the verification process set out

in paragraph 4. of this annex. The Technical Service shall ensure that this documentation package remains available for a period determined in agreement with the Approval Authority. This period shall be at least 10 years counted from the time when production of the vehicle is definitely discontinued.

- b) Additional material and analysis data of paragraph 3.4.4. which shall be retained by the manufacturer, but made open for inspection at the time of type approval. The manufacturer shall ensure that this material and analysis data remains available for a period of 10 years counted from the time when production of the vehicle is definitely discontinued.

### 3.2. Description of the functions of "The System"

A description shall be provided which gives a simple explanation of all the control functions of "The System" and the methods employed to achieve the objectives, including a statement of the mechanism(s) by which control is exercised.

Any described function that can be over-ridden shall be identified and a further description of the changed rationale of the function's operation provided.

- 3.2.1. A list of all input and sensed variables shall be provided and the working range of these defined.

- 3.2.2. A list of all output variables which are controlled by "The System" shall be provided and an indication given, in each case, of whether the control is direct or via another vehicle system. The range of control (paragraph 2.7.) exercised on each such variable shall be defined.

- 3.2.3. Limits defining the boundaries of functional operation (paragraph 2.8.) shall be stated where appropriate to system performance.

### 3.3. System layout and schematics

#### 3.3.1. Inventory of components.

A list shall be provided, collating all the units of "The System" and mentioning the other vehicle systems which are needed to achieve the control function in question.

An outline schematic showing these units in combination, shall be provided with both the equipment distribution and the interconnections made clear.

#### 3.3.2. Functions of the units

The function of each unit of "The System" shall be outlined and the signals linking it with other units or with other vehicle systems shall be shown. This may be provided by a labelled block diagram or other schematic, or by a description aided by such a diagram.

#### 3.3.3. Interconnections

Interconnections within "The System" shall be shown by a circuit diagram for the electric transmission links, by a piping diagram for pneumatic or hydraulic transmission equipment and by a simplified diagrammatic layout for mechanical linkages. The transmission links both to and from other systems shall also be shown.

3.3.4. Signal flow, operating data and priorities

There shall be a clear correspondence between these transmission links and the signals and/or operating data carried between Units. Priorities of signals and/or operating data on multiplexed data paths shall be stated wherever priority may be an issue affecting performance or safety as far as this UN Regulation is concerned.

3.3.5. Identification of units

Each unit shall be clearly and unambiguously identifiable (e.g. by marking for hardware and marking or software output for software content) to provide corresponding hardware and documentation association.

Where functions are combined within a single unit or indeed within a single computer, but shown in multiple blocks in the block diagram for clarity and ease of explanation, only a single hardware identification marking shall be used. The manufacturer shall, by the use of this identification, affirm that the equipment supplied conforms to the corresponding document.

3.3.5.1. The identification defines the hardware and software version and, where the latter changes such as to alter the function of the Unit as far as this Regulation is concerned, this identification shall also be changed.

3.4. Safety concept of the manufacturer

3.4.1. The manufacturer shall provide a statement which affirms that the strategy chosen to achieve "The System" objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.

3.4.2. In respect of software employed in "The System", the outline architecture shall be explained and the design methods and tools used shall be identified. The manufacturer shall show evidence of the means by which they determined the realisation of the system logic, during the design and development process.

3.4.3. The Manufacturer shall provide the Technical Service with an explanation of the design provisions built into "The System" so as to generate safe operation under fault conditions. Possible design provisions for failure in "The System" are for example::

- (a) Fall-back to operation using a partial system.
- (b) Change-over to a separate back-up system.
- (c) Removal of the high level function.

In case of a failure, the driver shall be warned for example by warning signal or message display. When the system is not deactivated by the driver, e.g. by turning the ignition (run) switch to "off", or by switching off that particular function if a special switch is provided for that purpose, the warning shall be present as long as the fault condition persists.

3.4.3.1. If the chosen provision selects a partial performance mode of operation under certain fault conditions, then these conditions shall be stated and the resulting limits of effectiveness defined.

3.4.3.2. If the chosen provision selects a second (back-up) means to realise the vehicle control system objective, the principles of the change-over mechanism, the logic and level of redundancy and any built in back-up checking features shall be explained and the resulting limits of back-up effectiveness defined.

3.4.3.3. If the chosen provision selects the removal of the Higher Level Function, all the corresponding output control signals associated with this function shall be inhibited, and in such a manner as to limit the transition disturbance.

3.4.4. The documentation shall be supported, by an analysis which shows, in overall terms, how the system will behave on the occurrence of any individual hazard or fault which will have a bearing on vehicle control performance or safety.

The chosen analytical approach(es) shall be established and maintained by the Manufacturer and shall be made open for inspection by the Technical Service at the time of the type approval.

The Technical Service shall perform an assessment of the application of the analytical approach(es). The audit shall include:

- (a) Inspection of the safety approach at the concept (vehicle) level with confirmation that it includes consideration of interactions with other vehicle systems. This approach shall be based on a Hazard / Risk analysis appropriate to system safety.
- (b) Inspection of the safety approach at the system level. This approach shall be based on a Failure Mode and Effect Analysis (FMEA), a Fault Tree Analysis (FTA) or any similar process appropriate to system safety.
- (c) Inspection of the validation plans and results. This validation shall use, for example, Hardware in the Loop (HIL) testing, vehicle on-road operational testing, or any means appropriate for validation.

The assessment shall consist of checks of hazards and faults chosen by the Technical Service to establish that the manufacturer's explanation of the safety concept is understandable, logical and that the validation plans are suitable and have been completed.

The Technical Service may perform or may require to perform tests as specified in paragraph 4. to verify the safety concept.

3.4.4.1. This documentation shall itemize the parameters being monitored and shall set out, for each fault condition of the type defined in paragraph 3.4.4. of this annex, the warning signal to be given to the driver and/or to service/technical inspection personnel.

3.4.4.2. This documentation shall describe the measures in place to ensure the "The System" does not prejudice the safe operation of the vehicle when the performance of "The System" is affected by environmental conditions e.g. climatic, temperature, dust ingress, water ingress, ice packing.

#### 4. VERIFICATION AND TEST

4.1. The functional operation of "The System", as laid out in the documents required in paragraph 3., shall be tested as follows:

4.1.1. Verification of the function of "The System"

The Technical Service shall verify "The System" under non-fault conditions by testing a number of selected functions from those declared by the manufacturer in paragraph 3.2. above.

For complex electronic systems, these tests shall include scenarios whereby a declared function is overridden.

4.1.2. Verification of the safety concept of paragraph 3.4.

The reaction of "The System" shall be checked under the influence of a failure in any individual unit by applying corresponding output signals to electrical units or mechanical elements in order to simulate the effects of internal faults within the unit. The Technical Service shall conduct this check for at least one individual unit, but shall not check the reaction of "The System" to multiple simultaneous failures of individual units.

The Technical Service shall verify that these tests include aspects that may have an impact on vehicle controllability and user information (HMI aspects)..

4.1.2.1. The verification results shall correspond with the documented summary of the failure analysis, to a level of overall effect such that the safety concept and execution are confirmed as being adequate.

5. Reporting by Technical Service

Reporting of the assessment by the Technical Service shall be performed in such a manner that allows traceability, e.g. versions of documents inspected are coded and listed in the records of the Technical Service.

An example of a possible layout for the assessment form from the Technical Service to the Type Approval Authority is given in Appendix 1 to this Annex.

## Annex 3 - Appendix 1

### Model assessment form for electronic systems

TEST REPORT NO:.....

#### 1. IDENTIFICATION

- 1.1. Vehicle make:
- 1.2. Type:
- 1.3. Means of identification of type if marked on the vehicle:
  - 1.3.1. Location of that marking:
- 1.4. Manufacturer's name and address:
- 1.5. If applicable, name and address of manufacturer's representative:
- 1.6. Manufacturer's formal documentation package:
  - Documentation reference No: .....
  - Date of original issue: .....
  - Date of latest update:.....

#### 2. TEST VEHICLE(S)/SYSTEM(S) DESCRIPTION

- 2.1. General description:
- 2.2. Description of all the control functions of "The System", and methods of operation:
- 2.3. Description of the components and diagrams of the interconnections within "The System":

#### 3. MANUFACTURER'S SAFETY CONCEPT

- 3.1. Description of signal flow and operating data and their priorities:
- 3.2. Manufacturer's declaration:

*The manufacturer(s) ..... affirm(s) that the strategy chosen to achieve "The System", objectives will not, under non-fault conditions, prejudice the safe operation of the vehicle.*
- 3.3. Software outline architecture and the design methods and tools used:
- 3.4. Explanation of design provisions built into "The System" under fault conditions:
- 3.5. Documented analyses of the behaviour of "The System" under individual hazard or fault conditions:
- 3.6. Description of the measures in place for environmental conditions:
- 3.7. Provisions for the periodic technical inspection of "The System":
- 3.8. Results of "The System" verification test, as per para. 4.1.1. of Annex 6 to UN Regulation No. 79:

3.9. Results of safety concept verification test, as per para. 4.1.2. of Annex 6 to UN Regulation No. 79:

3.10. Date of test:

3.11. This test has been carried out and the results reported in accordance with ..... to UN Regulation No. 79 as last amended by the ..... series of amendments.

Technical Service <sup>1/</sup> carrying out the test

Signed: ..... Date: .....

3.12. Type Approval Authority <sup>1/</sup>

Signed: ..... Date: .....

3.13. Comments:

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<sup>1/</sup> To be signed by different persons even when the Technical Service and Type Approval Authority are the same or alternatively, a separate Type Approval Authority authorization is issued with the report.

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## JUSTIFICATION

The above text is the result of the discussions of the informal group up to now. It was drafted by the Chair as a follow up of the 5th meeting which took place on 26-27 June 2018. Experts from OICA, CLEPA, AUS, EC, UK, JP, KOREA, FR, DE, NL and SE contributed to this work although not at all sessions.

The purpose of this proposal is to define requirements for automated emergency braking for cars (M1) and vans (N1) in the form of a new UN Regulation as agreed at the last GRRF session. The draft covers AEBS to avoid/mitigate collision with other cars/trucks, pedestrian and bicycles in line with the terms of reference of the informal group. The group reviewed accident data and existing tests procedures (e.g. EuroNcap, Japan NCap).

On this basis, for car to car collisions, the group agreed on two scenarios to be covered: collision with moving and stationary targets. Given that AEBS is a driver assist system, the group agreed to use the concept of last point to steer/last point to brake where the AEBS should only brake when the driver is not able to avoid collision by steering and braking.. The different parameters to implement this concept have been heavily debated and assessed (reaction time for braking, reaction time for steering, etc.) with speed reduction for full avoidance ranging from 35 km/h to 50 km/h. As a conclusion the group agreed on a compromise for the speed reduction of 42 km/h for a full avoidance.

For car to pedestrian, the agreed scenario is a crossing pedestrian. The tentative compromise reached for full avoidance is 30 km/h speed reduction to apply from the date of entry into force of the regulation and 42 km/h speed reduction to apply from 2023.

For car to cyclist, the group agreed from accident data that the two most relevant scenarios are a cyclist crossing (similar to pedestrian scenario) and a cyclist driving in the same direction as the car (similar to car to car scenario). However, for the latter, it seems that steering is much more efficient than braking, so the usefulness of such a braking test needs to be checked again.

The group still faces difficulty in agreeing on performance requirements for the car to bicycle collision given the lack of vehicles with this technology on the market (only one vehicle was tested under EuroNcap in 2018). One alternative would be to require simply a warning in a first step or to discuss this issue again after the finalization of the discussion on cars and pedestrians.

Remaining open issues are indicated in square brackets in the document. One major issue is r the minimum requirements that shall be required when the vehicle is outside test conditions (e.g. different mass, different road conditions). In addition for both car to car and car to pedestrian, few issues remain opened for some particular cases (e.g. for vans derived from trucks approved under Regulation R 13).

The phases of implementation would also need guidance from GRVA. In particular it is proposed that car to car requirements (42 km/h collision avoidance) as well as car to pedestrian with reduced performance (collision avoidance at 30 km/h only) would apply from the date of entry into force (original version of the regulation from 2020 for new types) whereas the car to pedestrian with higher speed (42 km/h) would apply in a second step (2023 for new types). The introduction phase for car to bicycle could then come later

The group would also need guidance on the way to refer to the latest version of UN Regulation 10 and to targets (ISO standard or copy/paste requirements) to ensure a coherent practice across the different GRs (e.g. target used for cyclist detection by trucks currently discussed in GRSG).

The group also discussed the possibility of a manual deactivation of the AEBS function. The compromise reached was that such a switch could be allowed but switching off the AEBS should not be too easy. However this compromise was not unanimously supported by all Contracting parties

The next meeting is scheduled to be held in Paris on 1-2 October June 2018. The focus will be on the test requirements which at this stage have not been fully discussed as the group first focused on performance requirements. The objective is a final vote in GRVA in February 2019 for the first stage of the regulation.