Draft

AUTOMOTIVE INDUSTRY STANDARD

Approval of vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles

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CHECK LIST FOR PREPARING AUTOMOTIVE INDUSTRY STANDARD

Draft AIS-185: Approval of vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles

SR. NO.	PARTICULARS	REMARKS
1.	Indicate details of the base reference standard. (e.g. ECE / EEC Directive/GTR etc.)	UN R 152, Supplement 5 to 00 Series of Amendments
2.	Add an explanatory note indicating differences between the above standard and the draft, if any.	N.A.
3.	Specify details of technical specifications to be submitted at the time of type approval relevant to the requirements of this standard covered.	As specified in Appendix 1 to Annex 1 of standard.
4.	Are the details of Worst Case Criteria covered?	Yes
5.	Are the performance requirements covered?	Yes
6.	Is there a need to specify dimensional requirements?	Yes
7.	If yes, are they covered?	Yes
8.	Is there a need to specify COP requirements? If yes, are they covered?	No
9.	Is there a need to specify type approval and routine test separately, as in the case of some of the Indian Standards? If yes, are they covered?	No
10.	If the standard is for a part / component or sub-system; i) AIS-037 or ISI marking scheme be implemented for this part? ii) Are there any requirements to be covered for this part when fitted on the vehicle? If yes, has a separate standard been prepared?	No.
11.	If the standard is intended for replacing or revising an already notified standard, are transitory provisions for re-certification of already certified parts/vehicles by comparing the previous test result, certain additional test, etc. required? If yes, are they included?	No.
12.	Include details of any other international or foreign national standards which could be considered as alternate standard.	No

13.	Are the details of accuracy and least counts of test equipment/meters required to be specified? If yes, have they been included?	Yes
14.	What are the test equipment for establishing compliance?	As specified in this standard.
15.	If possible, identify such facilities available in India.	Testing agencies under CMV Rule 126
16.	Are there any points on which special comments or information is to be invited from members? If yes, are they identified?	No
17.	Does the scope of standard clearly identify vehicle categories?	Yes
18.	Has the clarity of definitions been examined?	Yes

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the erstwhile Ministry of Surface Transport (MoST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the secretariat of the AIS Committee, has published this standard.

In a pursuit towards enhancing active safety in terms of braking provisions, formulation of this standard based on UN Regulation 152 on Advanced Emergency Braking System (AEBS) is taken up. AEBS automatically detects a potential forward collision, provide the driver with an appropriate warning and subsequently 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 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.

This Regulation cannot cover all the traffic conditions and infrastructure features in the type-approval process; this Regulation recognises that the performances re-quired 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.

Referring methodology of implementation of the regulation for car to car scenario and car to pedestrian scenario followed internationally, India also has decided to consider car to cyclist scenario for future implementation.

While preparation of this standard considerable assistance is derived from following regulation:

UN Regulation 152 (Supplement 5 to 00 Series of amendments)	Uniform provisions concerning the approval of motor vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles

The AISC panel and the Automotive Industry Standards Committee (AISC) responsible for preparation of this standard are given in Annexures*.....(To be included).*

Draft AIS-185/D5: Approval of vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles

Approval of vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles

1.0	**Scope**	
	This Standard applies to the approval of vehicles of Category M1 and N1 when equipped with an on-board system to :	
	Part 1 : Avoid or mitigate the severity of a rear-end in lane collision with a passenger car,	
	Part 2 : Avoid or mitigate the severity of an impact with a pedestrian.	
2.0	**References**	
2.1.1	UN R 152	Approval of motor vehicles with regard to the Advanced Emergency Braking System (AEBS) for M1 and N1 vehicles.
2.1.2	AIS-004 (Part 3) [Rev. 1]	Automotive Vehicles - Requirements for Electromagnetic Compatibility
3.0	**Definitions** For the purpose of this standard :	
3.1	"*Advanced Emergency Braking System (AEBS)*" means a system which can automatically detect an imminent forward collision and activate the vehicle braking system to decelerate the vehicle with the purpose of avoiding or mitigating a collision.	
3.2	"*Emergency Braking*" means a braking demand emitted by the AEBS to the service braking system of the vehicle.	
3.3	"*Collision Warning"* means a warning emitted by the AEBS to the driver when the AEBS has detected an imminent forward collision.	
3.4	"*Vehicle Type with Regard to its Advanced Emergency Braking System*" means a category of vehicles which do not differ in such essential aspects 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.	
3.5	"*Subject Vehicle*" means the vehicle being tested.	
3.6	"*Soft Target"* means a target that will suffer minimum damage and cause minimum damage to the subject vehicle in the event of a collision.	
3.7	"V*ehicle Target*" means a target that represents a vehicle	
3.8	"*Pedestrian Target*" means a soft target that represents a pedestrian	
3.9	"*Common Space*" means an area on which two or more information functions (e.g. symbol) may be displayed, but not simultaneously.	
3.10	"*Self-Check*" means an integrated function that checks for a system failure on a continuous basis at least while the system is active.	
3.11	"*Time To Collision (TTC)*" means the value of time obtained by dividing the longitudinal distance (in the direction of travel of the subject vehicle) between the subject vehicle and the target by the longitudinal relative speed of the subject vehicle and the target, at any instant in time.	
3.12	"*Dry road* affording good adhesion" means a road with a sufficient nominal* Peak Braking Coefficient (PBC) that would permit: (a) A mean fully developed deceleration of at least 9 m/s2; or (b) The design maximum deceleration of the relevant vehicle; Whichever is lower. * The "nominal" value is understood as being the minimum theoretical target value.	

3.13	"Sufficient nominal *Peak Braking Coefficient (PBC)*": means a road surface friction coefficient of: (a) 0.9, when measured using the American Society for Testing and Materials (ASTM) of E1136-19 standard reference test tyre in accordance with ASTM Method E1337-19 at a speed of 40 mph (64 Kmph); (b) 1.017, when measured using either: (i) The American Society for Testing and Materials (ASTM) of F2493-20 standard reference test tyre in accordance with ASTM Method E1337-19 at a speed of 40 mph (64 Kmph);; or (ii) The k-test method specified in E-7 to Annex E of IS 15986: 2015 or Annexure E-7 of AIS 151: 2018 or Annexure M-8 of IS 11852: 2013 or Annexure M-8 of AIS 150: 2018.
3.14	"*Initialisation*" means the process of setting-up the operation of the system after switching ON the vehicle until it is fully functioning.
3.15	"*Unladen Mass*" of a vehicle means the mass of vehicle with bodywork, including coolant, oils, at least 90 per cent of fuel, 100 per cent of other liquids.
3.16	"*Maximum mass* " means the maximum mass stated by the vehicle manufacturer to be technically permissible
3.17	"*The mean fully developed deceleration (dm)*" shall be calculated as the deceleration averaged with respect to distance over the interval vb to ve, according to the following formula: $d_m = \frac{v_b^2 - v_e^2}{25.92(s_e - s_b)}$ Where: v_o = initial vehicle speed in km/h, v_b = vehicle speed at 0.8 v_o in km/h, v_e = vehicle speed at 0.1 v_o in km/h, s_b = distance travelled between v_o and v_b in metres, s_e = distance travelled between v_o and v_e in metres. The speed and distance shall be determined using instrumentation having an accuracy of ±1 per cent at the prescribed speed for the test. The d_m may be determined by other methods than the measurement of speed and distance; in this case, the accuracy of the d_m shall be within ±3 per cent.
4.0	**Specifications**
4.1	General requirements
4.1.1	Any vehicle fitted with an AEBS complying with the definition of paragraph 3.1 above shall, when activated and operated within the prescribed speed ranges, meet the performance requirements:
4.1.1.1	of paragraphs 5.1 to 5.3 of this Standard for M1 and N1 vehicles.
4.1.1.2	of Part 1 (Clause 6) of this Standard for vehicles submitted to approval for Car to car scenario;
4.1.1.3	of Part 2(Clause 7) of this Standard for vehicles submitted to approval for Car to pedestrian scenario.
4.1.2	The effectiveness of AEBS with respect to EMI/EMC shall be demonstrated by fulfilling the technical requirements of AIS-004 (Part 3) [Rev 1].
4.1.3	Conformity with the safety aspects of electronic control systems shall be shown by meeting the requirements of Annex 1.
4.1.4	Warnings In addition to the collision warnings described in paragraphs 6.1.1 and 7.1.1, the system shall provide the driver with appropriate warning(s) as below:
4.1.4.1	A failure warning when there is a failure in the AEBS that prevents the requirements of this Standard of being met. The warning shall be as specified in paragraph 5.3.4
4.1.4.1.1	There shall not be an appreciable time interval between each AEBS self-check, and subsequently there shall not be a delay in illuminating the warning signal, in the case of an electrically detectable failure.
4.1.4.1.2	Upon detection of any non-electrical failure condition (e.g. sensor blindness or sensor misalignment), the warning signal as defined in paragraph 4.1.4.1 shall be illuminated.

4.1.4.2	If the system has not been initialised after a cumulative driving time of 15 seconds above a speed of 10km/h, information of this status shall be indicated to the driver. This information shall exist until the system has been successfully initialised.
4.1.4.3	A deactivation warning, if the vehicle is equipped with a means to deactivate the AEBS, shall be given when the system is deactivated. This shall be as specified in paragraph 5.2.3
4.1.5	Emergency braking Subject to the provisions of paragraphs 5.1.1 and 5.1.2, the system shall provide emergency braking interventions described in paragraphs 6.1.2. and 7.1.2 having the purpose of significantly decreasing the speed of the subject vehicle.
4.1.6	False reaction avoidance The system shall be designed to minimise the generation of collision warning signals and to avoid advanced emergency braking in situations where there is no risk of an imminent collision. This shall be demonstrated in the assessment carried out under Annex 1, and this assessment shall include in particular scenarios listed in Appendix 2 of Annex 1.
4.1.7	Any vehicle fitted with an AEBS shall meet the performance requirements of AIS 151: 2018 or IS 15986: 2015 as amended from time to time for vehicles of Category M_1 and N_1 or AIS 150: 2018 or IS 11852: 2013 as amended from time to time for vehicles of Category N_1 and shall be equipped with an anti-lock braking function in accordance with the performance requirements of AIS 151: 2018 or IS 15986: 2015 or AIS 150: 2018 or IS 11852: 2013 as amended from time to time.
5.0	**Specific Requirements**
5.1	Interruption by the Driver
5.1.1	The AEBS shall provide the means for the driver to interrupt the collision warning and the emergency braking.
5.1.2	In both cases above this interruption may be initiated by any positive action (e.g. kickdown, 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 Test Agency at the time of type approval and it shall be annexed to the test report.
5.2	Deactivation
5.2.1	When a vehicle is equipped with a means to manually deactivate the AEBS function. The following conditions shall apply as appropriate:
5.2.1.1	The AEBS function shall be automatically reinstated at the initiation of each new engine start/run cycle. This requirement does not apply when a new engine start/run cycle is performed automatically, e.g. the operation of a stop/start system.
5.2.1.2	The AEBS control shall be designed in such a way that manual deactivation shall not be possible with less than two deliberate actions.
5.2.1.3	The AEBS control shall be installed so as to comply with the relevant requirements and transitional provisions of AIS 071 as amended from time to time.
5.2.1.4	It shall not be possible to manually deactivate the AEBS at a speed above 10 km/h.
5.2.2	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, the following conditions shall apply as appropriate:
5.2.2.1	The vehicle manufacturer shall provide a list of situations and corresponding criteria where the AEBS function is automatically deactivated to the Test Agency at the time of type approval and it shall be annexed to the test report.
5.2.2.2	The AEBS function shall be automatically reactivated as soon as the conditions that led to the automatic deactivation are not present anymore.

5.2.2.3	Where automatic deactivation of the AEBS function is a consequence of the driver manually switching off the ESC function of the vehicle, this deactivation of the AEBS shall require at least two deliberate actions by the driver.
5.2.2.4	While automated driving functions are in longitudinal control of the vehicle (e.g. ALKS is active) the AEBS function may be suspended or its control strategies (i.e. braking demand, warning timing) adapted without indication to the driver, as long as it remains ensured that the vehicle provides at least the same collision avoidance capabilities as the AEBS function during manual operation.
5.2.3	A constant optical warning signal shall inform the driver that the AEBS function has been deactivated. The yellow warning signal specified in paragraph 5.3.4 below may be used for this purpose.
5.3	Warning Indication
5.3.1	The collision warning referred to in paragraphs 6.1.1 and 7.1.1 shall be provided by at least two modes selected from acoustic, haptic or optical.
5.3.2	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.
5.3.3	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 5.3.4
5.3.4	The failure warning referred to in paragraph 4.1.4.1 shall be a constant yellow optical warning signal.
5.3.5	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" position 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.
5.3.6	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.
5.3.7	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. The failure warning signal specified in paragraph 5.3.4 above may be used for this purpose.
6.0 Part 1	**Car to car scenario**
6.1	Specific Requirements
6.1.1	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, is imminent, a collision warning shall be provided as specified in paragraph 5.3.1 and shall be triggered at the latest 0.8 seconds before the start of emergency braking. However, in case the collision cannot be anticipated in time to give a collision warning 0.8 seconds ahead of an emergency braking, a collision warning shall be provided as specified in paragraph 5.3.1 and shall be provided no later than the start of emergency braking intervention. The collision warning may be aborted if the conditions prevailing a collision are no longer present. This shall be tested according to paragraphs 6.5. and 6.6.
6.1.2	Emergency braking When the system has detected the possibility of an imminent collision, there shall be a braking demand of at least 5.0 m/s^2 to the service braking system of the vehicle. The emergency braking may be aborted if the conditions prevailing a collision are no longer present. This shall be tested in accordance with paragraphs 6.5 and 6.6 of this Standard.
6.1.3	Speed range The system shall be active at least within the vehicle speed range between 10 km/h and 60 km/h and at all vehicle load conditions, unless deactivated as per paragraph 5.2

6.1.4 Speed reduction by braking demand

In absence of driver's input which would lead to interruption according to paragraph 5.1.2, the AEBS shall be able to achieve a relative impact speed that is less or equal to the maximum relative impact speed as shown in the following table:

(a) For collisions with unobstructed and constantly travelling or stationary targets;
(b) On flat, horizontal and dry roads affording good adhesion;
(c) In maximum mass and unladen mass conditions;
(d) In situations where the vehicle longitudinal centre planes are displaced by not more than 0.2 m;
(e) In ambient illumination conditions of at least 1000 Lux without direct blinding of sensors (e.g. direct blinding sunlight);
(f) In absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 0 deg. C); and
g) When driving straight with no curve and not turning at an intersection.

It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed above. However, the system shall not deactivate or unreasonably switch the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 1 of this Standard.

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

Relative Speed (km/h)	Stationary/ Moving	
	Maximum mass	Unladen Mass
10	0.00	0.00
15	0.00	0.00
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	0.00
45	15.00	15.00
50	25.00	25.00
55	30.00	30.00
60	35.00	35.00

*) For relative speeds between the listed values (e.g. 53 km/h), the maximum relative impact speed (i.e. 30/30 km/h) assigned to the next higher relative speed (i.e. 55 km/h) shall apply.

For masses above the unladen mass, the maximum relative impact speed assigned to the maximum mass shall apply.

Maximum relative Impact Speed (km/h) for N1 vehicles*

Relative Speed (km/h)	Stationary/Moving			
	Maximum mass		Unladen Mass	
	$\alpha > 1.3$	$\alpha \leq 1.3$	$\alpha > 1.3$	$\alpha \leq 1.3$
10	0.00	0.00	0.00	0.00
15	0.00	0.00	0.00	0.00
20	0.00	0.00	0.00	0.00
25	0.00	0.00	0.00	0.00
30	0.00	0.00	0.00	0.00
32	0.00	15.00	0.00	0.00
35	0.00	15.00	0.00	0.00
38	0.00	20.00	0.00	15.00

	40	10.00	20.00	0.00	15.00
	42	15.00	25.00	0.00	20.00
	45	20.00	25.00	15.00	25.00
	50	30.00	35.00	25.00	30.00
	55	35.00	40.00	30.00	35.00
	60	40.00	45.00	35.00	40.00

* All values in km/h

*) For relative speeds between the listed values (e.g. 53 km/h), the maximum relative impact speed (i.e. 35/40/30/35 km/h) assigned to the next higher relative speed (i.e. 55 km/h) shall apply.
For masses above the unladen mass, the maximum relative impact speed assigned to the maximum mass shall apply.

with $\alpha = Wr/W \times L/H$, where:
(a) Wr is the rear axle load.
(b) W is the subject vehicle unladen mass.
(c) L is the subject vehicle wheelbase.
(d) H is the subject vehicle centre of gravity height in unladen condition.
The speed reduction shall be demonstrated according to paragraphs 6.5. and 6.6.
At the request of the manufacturer a N1 vehicle may be assessed according to the Requirements for $\alpha > 1.3$ regardless of its α value.

6.2	Test Conditions
6.2.1	The test shall be performed on a flat, dry concrete or asphalt, road affording good adhesion.
6.2.2	The ambient temperature shall be between 0 deg. C and 45 deg. C or as recommended by manufacturer & agreed by Test agency.
6.2.3	The horizontal visibility range shall allow the target to be observed throughout the test.
6.2.4	The tests shall be performed when there is no wind liable to affect the results.
6.2.5	Natural ambient illumination must be homogeneous in the test area and in excess of 1000 lux. It should be ensured that testing is not performed whilst driving towards, or away from the sun at a low angle.
6.2.6	At the request of the manufacturer and with the agreement of the Test agency, tests may be conducted under deviating test conditions (suboptimal conditions, e.g. on a not dry surface; below the specified minimum ambient temperature), whilst the performance requirements are still to be met.
6.3	Vehicle Conditions
6.3.1	Test mass The vehicle shall be tested: (a) Unladen mass Condition: There may be, in addition to the driver, an additional mass of maximum 125 kg where this additional mass includes the measuring equipment and a possible second person who is responsible for noting the results in order to demonstrate compliance with the requirements, and (b) At the maximum mass The load distribution shall be according to the manufacturer's recommendation and be annexed to the test report. No alteration shall be made once the test procedure has begun. During the series of test runs, the fuel level may decrease but shall never fall below 50%.
6.3.2	Pre-Test Conditioning
6.3.2.1	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 initialise 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. (c) The average temperature of the service brakes on the hottest axle of the vehicle, measured inside the brake linings or on the braking path of the disc or drum, is between 65 and 100 deg. C prior to each test run.

<table>
<tr><td>6.3.2.2</td><td>Details of the pre-test condition strategy requested by the vehicle manufacturer shall be identified and recorded in the vehicle type approval documentation.</td></tr>
<tr><td>6.3.3</td><td>The mounted tyres shall be identified and recorded in the vehicle type approval documentation.</td></tr>
<tr><td>6.4</td><td>Test Targets</td></tr>
<tr><td>6.4.1</td><td>The target used for the vehicle detection tests shall be a regular high-volume series production passenger car of Category M1 or alternatively a "soft target" representative of a passenger vehicle in terms of its identification characteristics applicable to the sensor system of the AEBS under test according to ISO 19206-3:-2021. The reference point for the location of the vehicle shall be the most rearward point on the centreline of the vehicle.</td></tr>
<tr><td>6.4.2</td><td>Details that enable the target(s) to be specifically identified and reproduced shall be recorded in the vehicle type approval documentation.</td></tr>
<tr><td>6.5</td><td>Warning and Activation Test with a Stationary Vehicle Target</td></tr>
<tr><td>6.5.1</td><td>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 0.2 m.

Tests shall be conducted with a vehicle travelling at speeds shown in the tables below for respectively M1 and N1 categories. If this is deemed justified, the Test Agency may test any other speeds listed in the table in paragraph 6.1.4. and within the prescribed speed range as defined in paragraphs 6.1.3.

Subject vehicle test speed for M1 category in stationary target scenario
<table>
<tr><td>Maximum mass</td><td>Unladen mass</td><td>Tolerance</td></tr>
<tr><td>20</td><td>20</td><td>+2/-0</td></tr>
<tr><td>40</td><td>42</td><td>+0/-2</td></tr>
<tr><td>60</td><td>60</td><td>+0/-2</td></tr>
</table>
Subject vehicle test speed for N1 category in stationary target scenario
<table>
<tr><td colspan="2">Maximum mass</td><td colspan="2">Unladen mass</td><td rowspan="2">Tolerance</td></tr>
<tr><td>α >1.3</td><td>α ≤1.3</td><td>α >1.3</td><td>α ≤1.3</td></tr>
<tr><td>20</td><td>20</td><td>20</td><td>20</td><td>+2/-0</td></tr>
<tr><td>38</td><td>30</td><td>42</td><td>35</td><td>+0/-2</td></tr>
<tr><td>60</td><td>60</td><td>60</td><td>60</td><td>+0/-2</td></tr>
</table>
The functional part of the test shall start when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a Time To Collision (TTC) of at least 4 seconds from the target.

From the start of the functional part until the point of collision there shall be no adjustment to any control of the subject vehicle by the driver other than slight adjustments to the steering control to counteract any drifting.</td></tr>
<tr><td>6.6</td><td>Warning and Activation Test with a Moving Vehicle Target</td></tr>
<tr><td>6.6.1</td><td>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 0.2m.

Tests shall be conducted with a vehicle travelling at speeds shown in the tables below for respectively M1 and N1 categories and target travelling at 20 km/h (with a tolerance of +0/-2 km/h for the target vehicles). If this is deemed justified, the Test Agency may test any other speeds for subject vehicle and target vehicle within the speed range as defined in paragraph 6.1.3.</td></tr>
</table>

<table>
<tr><td></td><td>
Subject vehicle test speed for M1 category in moving target scenario
<table>
<tr><th>Maximum mass</th><th>Unladen Mass</th><th>Tolerance</th></tr>
<tr><td>30</td><td>30</td><td>+2/-0</td></tr>
<tr><td>60</td><td>60</td><td>+0/-2</td></tr>
</table>
Subject vehicle test speed for N1 category in moving target scenario
<table>
<tr><th colspan="2">Maximum mass</th><th colspan="2">Unladen Mass</th><th rowspan="2">Tolerance</th></tr>
<tr><th>α >1.3</th><th>α ≤1.3</th><th>α >1.3</th><th>α ≤1.3</th></tr>
<tr><td>30</td><td>30</td><td>30</td><td>30</td><td>+2/-0</td></tr>
<tr><td>58</td><td>50</td><td>60</td><td>55</td><td>+0/-2</td></tr>
</table>
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.
</td></tr>
<tr><td>6.7</td><td>Failure Detection Test</td></tr>
<tr><td>6.7.1</td><td>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 5.3.4 above nor the optional manual AEBS deactivation control of paragraph 5.2.1 shall be disconnected.</td></tr>
<tr><td>6.7.2</td><td>The failure warning signal mentioned in paragraph 5.3.4 above shall be activated and remain activated not later than 10 s 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.</td></tr>
<tr><td>6.8</td><td>Deactivation Test</td></tr>
<tr><td>6.8.1</td><td>For vehicles equipped with means to manually deactivate the AEBS, turn the ignition (start) switch to the "on" (run) position and deactivate the AEBS. The warning signal mentioned in paragraph 5.2.3 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.</td></tr>
<tr><td>6.9</td><td>Robustness of the system</td></tr>
<tr><td>6.9.1</td><td>Any of the above test scenarios, where a scenario describes one test setup at one subject vehicle speed at one load condition of Car to Car scenario shall be performed two times. If one of the two test runs fails to meet the required performance, the test may be repeated once. A test scenario shall be accounted as passed if the required performance is met in two test runs. The number of failed tests runs shall not exceed 10.0 per cent of the performed test runs.</td></tr>
<tr><td>6.9.2</td><td>The root cause of any failed test run shall be analysed together with the Test Agency and annexed to the test report. If the root cause cannot be linked to a deviation in the test setup, the Test Agency may test any other speeds within the speed range as defined in paragraph 6.1.3., and paragraph 6.1.4 for speed reduction by braking demand.</td></tr>
<tr><td>6.9.3</td><td>During the assessment as per Annex 1, the manufacturer shall demonstrate, via appropriate documentation, that the system is capable of reliably delivering the required performances.</td></tr>
</table>

7.0 Part 2	Car to Pedestrian scenario
7.1	Specific Requirements
7.1.1	Collision warning When the AEBS has detected the possibility of a collision with a pedestrian crossing the road at a constant speed of 5 km/h, a collision warning shall be provided as specified in paragraph 5.3.1 and shall be provided no later than the start of emergency braking intervention. The collision warning may be aborted if the conditions prevailing a collision are no longer present.
7.1.2	Emergency braking When the system has detected the possibility of an imminent collision, there shall be a braking demand of at least 5.0 m/s2 to the service braking system of the vehicle. The emergency braking may be aborted if the conditions prevailing a collision are no longer present. This shall be tested in accordance with paragraph 7.5 of this Standard.
7.1.3	Speed range The system shall be active at least within the vehicle speed range between 20 km/h and 60 km/h and at all vehicle load conditions, unless deactivated as per paragraph 5.2
7.1.4	Speed reduction by braking demand In absence of driver's input which would lead to interruption according to paragraph 5.1.2, the AEBS shall be able to achieve an impact speed that is less or equal to the maximum relative impact speed as shown in the following table: (a) With unobstructed perpendicularly crossing pedestrians with a lateral speed component of not more than 5 km/h; (b) In unambiguous situations (e.g. not multiple pedestrians); (c) On flat, horizontal and dry roads affording good adhesion; (d) In maximum mass and unladen mass conditions; (e) In situations where the anticipated impact point is displaced by not more than 0.2 m compared to the vehicle longitudinal centre plane; (f) In ambient illumination conditions of at least 2000 Lux without blinding of sensors (e.g. direct blinding Sunlight). (g) In absence of weather conditions affecting the dynamic performance of the vehicle (e.g. no storm, not below 0 deg. C) and h) When driving straight with no curve and not turning at an intersection. It is recognised that the performances required in this table may not be fully achieved in other conditions than those listed above. However, the system shall not deactivate or unreasonably switch the control strategy in these other conditions. This shall be demonstrated in accordance with Annex 1 of this Standard.

Maximum Impact Speed (km/h) for M_1*

Subject vehicle speed (km/h)	Maximum mass	Unladen Mass
20	0.00	0.00
25	0.00	0.00
30	0.00	0.00
35	20.00	20.00
40	25.00	25.00
45	30.00	30.00
50	35.00	35.00
55	40.00	40.00
60	45.00	45.00

*For subject vehicle speeds between the listed values (e.g. 53 km/h), the maximum impact speed (i.e. 40/40 km/h) assigned to the next higher subject vehicle speed (i.e. 55 km/h) shall apply.

For masses above the unladen mass, the maximum relative impact speed as-signed to the maximum mass shall apply.

Maximum Impact Speed (km/h) for N1 vehicles*

Subject vehicle speed (km/h)	Maximum mass		Unladen Mass	
	α >1.3	α ≤1.3	α >1.3	α ≤1.3
20	0.00	0.00	0.00	0.00
25	0.00	10.00	0.00	0.00
30	0.00	15.00	0.00	15.00
35	20.00	25.00	20.00	20.00
40	25.00	30.00	25.00	25.00
45	30.00	35.00	30.00	30.00
50	35.00	40.00	35.00	35.00
55	40.00	45.00	40.00	45.00
60	45.00	50.00	45.00	50.00

* All values in km/h

*) For subject vehicle speeds between the listed values (e.g. 53 km/h), the maximum impact speed (i.e. 40/45/40/45 km/h) assigned to the next higher subject vehicle speed (i.e. 55 km/h) shall apply.

For masses above the unladen mass, the maximum relative impact speed assigned to the maximum mass shall apply.

With $\alpha = Wr/W \times L/H$, where:

(a) Wr is the rear axle load.
(b) W is the subject vehicle laden mass
(c) L is the subject vehicle wheelbase.
(d) H is the subject vehicle centre of gravity height in unladen condition.

At the request of the manufacturer, a vehicle of the Category N1 may be assessed according to the Requirements for α >1.3 regardless of its α value.

The speed reduction shall be demonstrated according to paragraph 7.5.

7.2	Test Conditions
7.2.1	The test shall be performed on a flat, dry concrete or asphalt, road affording good adhesion.
7.2.2	The ambient temperature shall be between 0 deg. C and 45 deg. C or as recommended by manufacturer & agreed by Test agency.
7.2.3	The horizontal visibility range shall allow the target to be observed throughout the test.
7.2.4	The tests shall be performed when there is no wind liable to affect the results.
7.2.5	Natural ambient illumination must be homogeneous in the test area and in excess of 2000 lux. It should be ensured that testing is not performed whilst driving towards, or away from the sun at a low angle.
7.2.6	At the request of the manufacturer and with the agreement of the Test agency, tests may be conducted under deviating test conditions (suboptimal conditions, e.g. on a not dry surface; below the specified minimum ambient temperature), whilst the performance requirements are still to be met.
7.3	Vehicle Conditions
7.3.1	Test mass The vehicle shall be tested: (a) Unladen mass condition :There may be, in addition to the driver, an additional mass of maximum 125 kg where this additional mass includes the measuring equipment and a possible second person who is responsible for noting the results in order to demonstrate compliance with the requirements, and (b) At the maximum mass

<table>
<tr><td></td><td>The load distribution shall be according to the manufacturer's recommendation and be annexed to the test report. No alteration shall be made once the test procedure has begun.
During the series of test runs, the fuel level may decrease but shall never fall below 50%.</td></tr>
<tr><td>7.3.2</td><td>Pre-Test Conditioning</td></tr>
<tr><td>7.3.2.1</td><td>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 initialise 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.
(c) The average temperature of the service brakes on the hottest axle of the vehicle, measured inside the brake linings or on the braking path of the disc or drum, is between 65 and 100 deg. C prior to each test run.</td></tr>
<tr><td>7.3.2.2</td><td>Details of the pre-test condition strategy requested by the vehicle manufacturer shall be identified and recorded in the vehicle type approval documentation.</td></tr>
<tr><td>7.3.3</td><td>The mounted tyres shall be identified and recorded in the vehicle type approval documentation.</td></tr>
<tr><td>7.4</td><td>Test Targets</td></tr>
<tr><td>7.4.1</td><td>The target used for the pedestrian detection tests shall be a child "articulated soft target" and be representative of the human attributes applicable to the sensor system of the AEBS under test according to ISO 19206-2:2018.</td></tr>
<tr><td>7.4.2</td><td>Details that enable the target(s) to be specifically identified and reproduced shall be recorded in the vehicle type approval documentation.</td></tr>
<tr><td>7.5</td><td>Warning and Activation Test with a Pedestrian Target</td></tr>
<tr><td>7.5.1</td><td>The subject vehicle shall approach the impact point with the pedestrian target in a straight line for at least two seconds prior to the functional part of the test with an anticipated subject vehicle to impact point centreline offset of not more than 0.1 m.
The functional part of the test shall start when the subject vehicle is travelling at a constant speed and is at a distance corresponding to a TTC of at least 4 seconds from the collision point.
The pedestrian target shall travel in a straight line perpendicular to the subject vehicle's direction of travel at a constant speed of 5 km/h +/- 0.4 km/h, starting not before the functional part of the test has started. 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, with a tolerance of not more than 0.1 m.*/ if the subject vehicle would remain
at the prescribed test speed throughout the functional part of the test and does not brake.

Tests shall be conducted with a vehicle travelling at speeds shown in the tables below for respectively M1 and N1 categories. The Test Agency may test any other speeds listed in the table in paragraph 7.1.4. and within the prescribed speed range as defined in paragraphs 7.1.3.

Subject vehicle test speed for M1 category in pedestrian target scenario
<table>
<tr><th>Maximum mass</th><th>Unladen mass</th><th>Tolerance</th></tr>
<tr><td>20</td><td>20</td><td>+2/-0</td></tr>
<tr><td>30</td><td>30</td><td>+0/-2</td></tr>
<tr><td>60</td><td>60</td><td>+0/-2</td></tr>
</table>
All values in km/h

Subject vehicle test speed for N1 category in pedestrian target scenario
<table>
<tr><th colspan="2">Maximum mass</th><th colspan="2">Unladen mass</th><th rowspan="2">Tolerance</th></tr>
<tr><th>α >1.3</th><th>α ≤1.3</th><th>α >1.3</th><th>α ≤1.3</th></tr>
<tr><td>20</td><td>20</td><td>20</td><td>20</td><td>+2/-0</td></tr>
<tr><td>30</td><td>NA</td><td>30</td><td>25</td><td>+0/-2</td></tr>
<tr><td>60</td><td>60</td><td>60</td><td>60</td><td>+0/-2</td></tr>
</table>
All values in km/h

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.</td></tr>
</table>

	The test prescribed above shall be carried out with a child pedestrian "soft target" defined in 7.4.1.
7.5.2	The assessment of the impact speed shall be based on the actual contact point between the target and the vehicle, taking into account the vehicle shape.
7.6	Failure Detection Test
7.6.1	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 5.3.4 above nor the optional manual AEBS deactivation control of paragraph 5.2.1 shall be disconnected.
7.6.2	The failure warning signal mentioned in paragraph 5.3.4 above shall be activated and remain activated not later than 10 s 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.
7.7	Deactivation Test
7.7.1	For vehicles equipped with means to manually deactivate the AEBS, turn the ignition (start) switch to the "on" (run) position and deactivate the AEBS. The warning signal mentioned in paragraph 5.2.3 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.
7.8	Robustness of the system
7.8.1	Any of the above test scenarios, where a scenario describes one test setup at one subject vehicle speed at one load condition of Car to pedestrian scenario shall be performed two times. If one of the two test runs fails to meet the required performance, the test may be repeated once. A test scenario shall be accounted as passed if the required performance is met in two test runs. The number of failed tests runs shall not exceed 10.0 per cent of the performed test runs.
7.8.2	The root cause of any failed test run shall be analysed together with the Test Agency and annexed to the test report. If the root cause cannot be linked to a deviation in the test setup, the Test Agency may test any other speeds within the speed range as defined in paragraphs 7.1.3., and paragraph 7.1.4 for speed reduction by braking demand.
7.8.3	During the assessment as per Annex 1, the manufacturer shall demonstrate, via appropriate documentation, that the system is capable of reliably delivering the required performances.
8.0	**Part 3 Car to Cyclist scenario (Reserved)**
9.0	**MODIFICATION OF VEHICLE TYPE AND CRITERIA FOR EXTENSION OF APPROVAL**
9.1	Every modification of the vehicle type as defined in clause 3.4 of this Standard shall be notified to the test agency which approved the vehicle type. The test agency may then either:
9.1.1	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
9.1.2	Consider that the modifications made affect the conditions of the earlier granted type approval and would require further tests or additional checks before granting an extension of approval.
9.2	In case of 9.1.2, tests shall be carried out for only those parameters which are affected by the modifications.
9.3	In case of fulfilment of criteria of Para. 9.1.1 or after successful results of further verification as per para 9.1.2 the approval of compliance shall be extended for the changes carried out.

Annex 1

Special requirements to be applied to the safety aspects of electronic 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 2.4. below) as far as this Standard is concerned.

This annex shall also apply to safety related functions identified in this Standard whichare controlled by electronic system(s) (paragraph 2.3.) as far as this Standard is concerned.

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 Test Agency, for type approval purposes.

This information shall show that "The System" respects, under non-fault and fault conditions, all the appropriate performance requirements specified elsewhere in this Standard and that it is designed to operate in such a way that it does not induce safety critical risks.

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 Standard applies. This also includes any other system covered in the scope of this Standard, as well as transmission links to or from other systems that are outside the scope of this Standard, that acts on a function to which this Standard 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 become part of the complex system, as well as any overriding system/function within the scope of this Standard. The transmission links to and from overriding Systems/function outside of the scope of this Standard 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 dependson the sensed circumstances.

2.6. "***Units***" are the smallest divisions of system components which will be considered in thisannex, 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 morethan 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.

The Test Agency 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 Standard; 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 Test Agency at the time of submission of the type approval application. This documentation package shall be used by the Test Agency as the basic reference for the verification process set out in paragraph4.

of this annex. The Test Agency 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 timewhen 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 2.8.) exercised on each such variable shall be defined.

3.2.3. Limits defining the boundaries of functional operation (paragraph 2.9.) 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 Standard 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 Standard 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 Test Agency 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 Test Agency at the timeof the type approval.

The Test Agency 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 operationaltesting, or any means appropriate for validation.

The assessment shall consist of checks of hazards and faults chosen by the Test Agency 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 Test Agency 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 Test Agency shall verify "The System" under non-fault conditions by testinga 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 Test Agency shall conduct this check for at least one individual unit, but shallnot check the reaction of "The System" to multiple simultaneous failures of individual units.

The Test Agency 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.

5.0 Reporting by Test Agency

Reporting of the assessment by the Test Agency 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 Test Agency.

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

Annex 1 - 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: .....

1.4. Location of that marking: .....

1.5. Manufacturer's name and address: .....

1.6. If applicable, name and address of manufacturer's representative: .....

1.7. 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 behavior of "The System" under individual hazard or fault conditions: .....

3.6. Description of the measures in place for environmental conditions: .....

3.7 Results of "The System" verification test, as per para. 4.1.1. of Annex 1 to AIS-185: .....

3.7. Results of safety concept verification test, as per para. 4.1.2. of Annex 1 to AIS-185: .....

3.9 Date of test: .....

3.10 This test has been carried out and the results reported in accordance with AIS-185.

Test Agency carrying out the test

Signed: .....

Date: .....

3.11 Signed: Test agency .....

Date: .....

3.12. Comments:.....

Annex 1 - Appendix 2 False Reaction scenarios

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

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

(a) Definition of overlap ratio between the subject vehicle and the related vehicle

Overlap ratio between the subject vehicle and the related vehicle is calculated by the following formula.

$$R_{overlap} = L_{overlap} / W_{vehicle} * 100$$

Where:

$R_{overlap}$ *: Overlap ratio [%]*

$L_{overlap}$ *: Amount of overlap between extended lines of the width of the subject vehicle and the related vehicle [m]*

$W_{vehicle}$ *: Width of the subject vehicle [m] (sensors, devices for indirect vision, door handles and connections for tyre-pressure gauges are not included when measuring the width of the vehicle)*

(b) *Definition of offset ratio between the subject vehicle and the stationary object*

Offset ratio between the subject vehicle and the stationary object is calculated by the following formula.

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

R_{offset} *: Offset ratio [%]*

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

$W_{vehicle}$ *: Width of the subject vehicle [m] (sensors, devices for indirect vision, door handles and connections for tyre-pressure gauges are not included when measuring the width of the vehicle)*

Scenario 1

Left turn or Right turn at the intersection

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

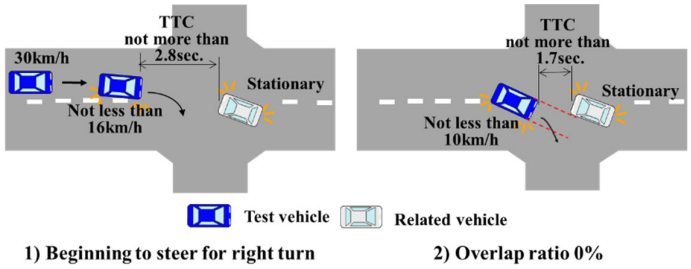
1.2. An example of the detail scenario:

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

Figure 1

Left turn or right turn at the intersection

Driving on left side of the road



Scenario 2

Right turn or Left turn of a forward vehicle

2.1. *In this scenario, the subject vehicle follows a forward vehicle. After that, the forward vehicle turns right or left at a corner, and the subject vehicle goes straight.*

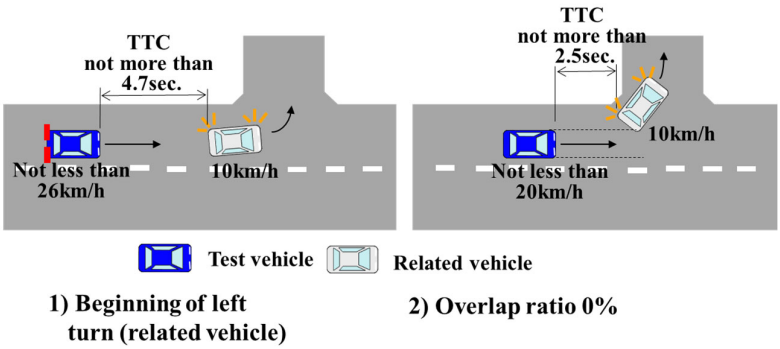
2.2. *An example of the detail scenario:*

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

Figure 2

Right turn or left turn of a forward vehicle

Driving on left side of the road



Scenario 3

Curved road with guard pipes and a stationary object

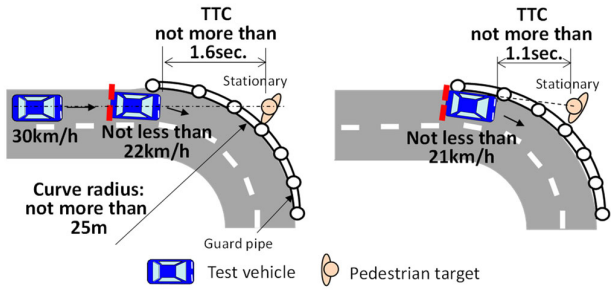
3.1. *In this scenario, the subject vehicle drives a small radius curved road of which the guard pipes are constructed to the outer side, and a stationary vehicle (M_1 category), a stationary pedestrian target is positioned just outside of the guard pipes and where on the extension of the centre of the lane.*

3.2. *An example of the detail scenario:*

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

Figure 3
Curved road with guard pipes and a stationary object

Driving on left side of the road



Scenario 4

Lane change due to road construction

4.1. *In this scenario, the subject vehicle changes the lane in front of the signboard which is positioned in the centre of the lane and notifies the driver that the lane is reduced.*

4.2. *An example of the detail scenario:*

The subject vehicle drives a straight road at a speed of 40 km/h (with a tolerance of +0/-2 km/h), and begins to steer in order to change the lane in front of the signboard which notifies reducing the lane. No other vehicles approach the subject vehicle. The TTC to the signboard is not more than 4.2 seconds at when the subject vehicle begins to steer. During changing the lane, the speed of the subject vehicle is constant, and the TTC to the signboard is not more than 3.3 seconds at when the offset ratio between the subject vehicle and the centre of the signboard becomes -100 per cent.

Figure 4

Lane change due to road construction

Driving on left side of the road