EURO NCAP

#FORSAFERCARS

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Assisted Driving Highway & Interurban Assist Systems

Protocol

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PREFACE

During the test preparation, vehicle manufacturers are encouraged to liaise with the laboratory and to check that they are satisfied with the way cars are set up for testing. Where a manufacturer feels that a particular item should be altered, they should ask the laboratory staff to make any necessary changes. Manufacturers are forbidden from making changes to any parameter that will influence the test, such as dummy positioning, vehicle setting, laboratory environment etc.

It is the responsibility of the test laboratory to ensure that any requested changes satisfy the requirements of Euro NCAP. Where a disagreement exists between the laboratory and manufacturer, the Euro NCAP secretariat should be informed immediately to pass final judgment. Where the laboratory staff suspect that a manufacturer has interfered with any of the set up, the manufacturer's representative should be warned that they are not allowed to do so themselves. They should also be informed that if another incident occurs, they will be asked to leave the test site.

Where there is a recurrence of the problem, the manufacturer's representative will be told to leave the test site and the Secretary General should be immediately informed. Any such incident may be reported by the Secretary General to the manufacturer and the person concerned may not be allowed to attend further Euro NCAP tests.

DISCLAIMER: Euro NCAP has taken all reasonable care to ensure that the information published in this protocol is accurate and reflects the technical decisions taken by the organisation. In the unlikely event that this protocol contains a typographical error or any other inaccuracy, Euro NCAP reserves the right to make corrections and determine the assessment and subsequent result of the affected requirement(s).

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DEFINITIONS

Throughout this protocol the following terms are used:

Vehicle under test (VUT) – means the vehicle tested according to this protocol with a pre-crash collision mitigation or avoidance system on board.

Global Vehicle Target (GVT) – means the vehicle target used in this protocol as defined inISO 19206-3:2021.

Secondary Other Vehicle (SOV) – means the "Large Obstruction Vehicle" as defined in the latest AEB VRU test protocol (and not a robot-controlled platform) used in the Cut-out test in this protocol.

Euro NCAP Pedestrian Target (EPTa) – means the articulated adult pedestrian target used in this protocol as specified in the ISO 19206-2:2018

Euro NCAP Bicyclist Target (EBTa) – means the adult bicyclist and bike target used in this protocol as specified in ISO 19206-4:2020

Euro NCAP Motorcyclist Target (EMT) – means the Motorcyclist target used in this protocol as specified in the deliverable D2.1 of the MUSE project (Fritz and Wimmer 2019) which at time of publication is to be replaced with ISO 19206-5.

Real Motorcycle – Means a motorcyclist target that can be used in the Blind-Spot Monitoring Tests of this protocol, as an alternative to the EMT. The Real Motorcycle shall be a type approved two-wheeled motorcycle, with a maximum speed of at least 80km/h by design, without front fairing or windshield. It shall closely resemble the EMT (as specified in section 2.1 of deliverable D2.1 of the MUSE project), thus staying within the mean dimensions of the most registered middleweight naked motorcycles in Europe (i.e. wheelbase >1405mm. and <1445mm.).

Time To Collision (TTC) – means the remaining time before the VUT strikes the GVT, assuming that the VUT and GVT would continue to travel with the speed it is travelling.

Speed Assist System (SAS) –a system that informs or warns the driver and/or controls thevehicle speed

Speed Limit Information Function (SLIF) – a function with which the vehicle knows and communicates the speed limit.

Speed Limitation Function (SCF) – a system which allows the driver to set a vehicle speedto which he wishes the speed of his car to be limited and above which he wishes to be warned.

Adaptive Cruise Control (ACC) – a system that controls the vehicle speed whilst maintaininga set distance to vehicles ahead

Intelligent Adaptive Cruise Control (iACC) – iACC is an ACC combined with SLIF, where thespeed is set by the SLIF with or without driver confirmation.

Autonomous Emergency Braking (AEB) – braking that is applied automatically by thevehicle in response to the detection of a likely collision to reduce the vehicle speed andpotentially avoid the collision.

Autonomous Emergency Steering (AES) – steering that is applied automatically by the vehicle in response to the detection of a likely collision to steer the vehicle around a target in front to avoid the collision.

Forward Collision Warning (FCW) – an audio-visual warning that is provided automaticallyby the vehicle in response to the detection of a likely collision to alert the driver.

Lane Support System (LSS) – a set of lateral control features that correct the vehicle heading to keep the vehiclewithin its driving lane and/or warns the driver.

Lane Centering (LC) – a function which assists the driver in keeping the vehicle within the chosen lane, by influencing the lateral movement of the vehicle.

Assisted Mode – Combination of ACC and LC.

Lane Change Assist (LCA) – a function which is initiated by the driver OR proposed by the system and confirmed by the driver, which can perform a single lateral manoeuvre (e.g. lane change).

Emergency Lane Keeping (ELK) – default ON heading correction that is applied automatically by the vehicle in response to the detection of the vehicle that is about to driftbeyond a solid lane marking, the edge of the road or into oncoming or overtaking traffic inthe adjacent lane.

Lane Keeping Assist (LKA) – heading correction that is applied automatically by the vehiclein response to the detection of the vehicle that is about to drift beyond a delineated edge line of the current travel lane.

Lane Departure Warning (LDW) – a warning that is provided automatically by the vehicle inresponse to the vehicle that is about to drift beyond a delineated edge line of the current travel lane.

Driver State Monitoring (DSM) – Driver State Monitoring system that is able to (in)directly determine the state of the driver

Direct Monitoring – Where driver state determination is supported by sensor(s) directly observing the driver.

Transient state – A state during which the driver's focus on the primary task of driving/controlling the vehicle is temporarily reduced, but can be immediately reversed (e.g. visual inattentiveness due to engaging in secondary tasks). The following Transient driver states are included in this assessment:

- **Long Distraction** – A single long duration distraction which takes the driver's gaze away from the forward road view.
- **Short Distraction / Visual Attention Time Sharing (VATS)** – Repeated short duration gazes away from the forward road view, which cumulatively reduce the driver's awareness of the driving situation, until their attention returns to the driving task for long enough for them to fully assess the driving situation.
- **Phone Use** – A subset of short distraction (VATS) where the object the driver's attention is shared with is their mobile phone.

Non-transient state – A state that partially or fully reduces the driver's capability to maintain focus and properly perform the driving task and that cannot be reversed without appropriate recovery time outside of the driving session. The following Non-transient driver states are included in this assessment:

- **Impairment** – Impaired driving negatively impacts driving performance, resulting in an increased crash risk. Impairment may either build up over time (typically drowsiness/sleepiness), or present itself from the start of the journey (non-fatigue related, e.g., from the use of alcohol and/or drugs that impair driver performance).
- **Microsleep** – A microsleep is a temporary episode of sleep after fatigue builds-up, which may last up to several seconds.
- **Sleep** – In this assessment sleep is considered as when a driver has been in a state of unconsciousness due to fatigue for a period of greater than a few seconds.
- **Unresponsive Driver** – Where a driver becomes unresponsive during driving, likely due to an

onset of sudden sickness or extreme fatigue.

Operational Design Domain (ODD) – operating conditions under which a system is specifically designed to function, e.g., environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.

Car-to-Car Rear Stationary (CCRs) – a collision in which a vehicle travels forwards towards another stationary vehicle and the frontal structure of the vehicle strikes the rear structure ofthe other.

Car-to-Car Rear Moving (CCRm) – a collision in which a vehicle travels forwards towardsanother vehicle that is travelling at constant speed and the frontal structure of the vehiclestrikes the rear structure of the other.

Car-to-Car Rear Braking (CCRb) – a collision in which a vehicle travels forwards towardsanother vehicle that is travelling at constant speed and then decelerates, and the frontal structure of the vehicle strikes the rear structure of the other.

Car-to-Motorcyclist Rear Stationary (CMRs) – a collision in which a vehicle travels forwards towards a motorcyclist and the front structure of the vehicle strikes the rear of the motorcycle.

Car-to-Motorcyclist Rear Moving (CMRm) – a collision in which a vehicle travels forwards towards a motorcyclist that is travelling at constant speed and the frontal structure of the vehiclestrikes the rear of the motorcycle.

Car-to-Motorcyclist Rear Braking (CMRb) – a collision in which a vehicle travels forwards towards a motorcyclist that is travelling at constant speed and then decelerates, and the frontal structure of the vehicle strikes the rear of the motorcycle.

Car-to-Pedestrian Longitudinal Adult 0% (CPLA-0) – a collision in which a vehicle travels forwards towards an adult pedestrian walking in the same direction in front of the vehicle where the vehicle strikes the pedestrian at 0% of the vehicle’s width when no braking action is applied.

Car-to-Bicyclist Longitudinal Adult 0% (CBLA-0) – a collision in which a vehicle travels forwards towards a bicyclist cycling in the same direction in front of the vehicle where the vehicle would strike the cyclist at 0% of the vehicle’s width when no braking action is applied.

1 HIGHWAY AND INTERURBAN ASSIST SYSTEMS

This protocol is developed to provide consumers with detailed information on Assisted Driving systems that are typically offered as an option and are as such not considered in the Euro NCAP star rating.

The assisted driving gradings will, for the time being, remain complementary to the overall rating and continue to be published separately from the star rating. Given the importance of the technology, its potential safety benefits, but also its associated risks, a penalty/rewards approach is introduced for cars that offer assisted driving systems, whether fitted as an option or standard. The vehicle being tested shall reach a minimum score of 50% of Driving Collaboration and Driver Monitoring respectively, to be eligible to score any points in the Driver Monitoring section (Protocol Safe Driving – Driver Engagement Chapter 1) of the Safety Rating.

For Highway and Interurban Assist systems, Euro NCAP focusses on two main areas: Assistance Competence,which is the balance between Vehicle Assistance and Driver Engagement, and Safety Backup. The sum of the scores in Assistance Competence and Safety Backup is used in a grading system, similar to the five-star safety rating.

Vehicles used for the assessment shall have all relevant assisted driving options included (even if fitted as a subscription), as assisted driving packages are usually optional.

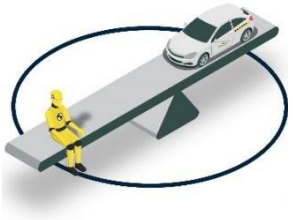
This protocol describes the details of all scoring elements within Driver Engagement, Vehicle Assistance and Safety Backup.

1.1 Balance principle

The Assistance Competence score is the balance between Vehicle Assistance and Driver Engagement. The higher the level of assistance, the more the driver must be engaged by the system.

In principle, the Assistance Competence score equals the Vehicle Assistance score, but only when the Driver Engagement score (at least) matches Vehicle Assistance. Where Vehicle Assistance outscores Driver Engagement, the Assistance Competence score is limited to the Driver Engagement performance.

ASSISTANCE COMPETENCE	SCORE
Driver Engagement ≥ Vehicle Assistance	Vehicle Assistance
Driver Engagement < Vehicle Assistance	Driver Engagement



1.2 Grading

The sum of Assistance Competence and Safety backup determines the Grading:

GRADING	SCORE REQUIRED
VERY GOOD	≥ 160 points (≥ 80%)
GOOD	≥ 140 points (≥ 70%)
MODERATE	≥ 120 points (≥ 60%)
ENTRY	≥ 100 points (≥ 50%)

2 ASSISTANCE COMPETENCE – DRIVER ENGAGEMENT

Assistance Competence – Driver Engagement	Total points 100
Consumer Information	**25**
System name	10
Marketing material	5
Quick start guide	5
Vehicle handbook	5
System Status	**25**
Continuous system status indicator	20
System status change indicator	5
Driver Monitoring	**25**
Hands-on Monitoring	5
Transient Driver States	20
Driving Collaboration	**25**
Override torque	5
Override response	20

2.1 Consumer Information

Consumer Information	Total points 25
System name	**10**
Marketing material	**5**
Quick start guide	**5**
Quick start guide availability	3
Integration on infotainment	2
Vehicle handbook	**5**

Drivers expectations of how much assistance the system provides them may be influenced by information they are supplied prior to them operating the system. It shall be clear to any potential driver that the system is an assistance system only and that driver oversight is always required. This assessment is designed to examine the information supplied to the consumer relating to the assistance system.

2.1.1 System Name

When the Vehicle Manufacturer markets the longitudinal and lateral assistance systems under a single name, this name shall be used. If the Vehicle Manufacturer markets the longitudinal and lateral control systems separately, the name of each shall be assessed and the lowest of the two scores shall be used.

A system name shall contain the word “assistant”, “assistance”, “assist” or another variationof the term. If this is the case, 10 points are awarded.

The system name shall not contain the word “auto”, “automatic”, “automated”, any other variation of the term or another term which is deemed to imply a level of automation higher than which the system is offering. E.g. “pilot”, “self-drive”, etc.

Where a system’s name neither contains the term “assist” nor a variant of “auto” or “pilot”, 5 points are awarded.

2.1.2 Marketing Material

Euro NCAP cannot monitor and assess every piece of marketing material related to the VUT inall countries where the system is sold. However, during the assessment, time will be taken to review publicly available marketing material, relating to the system assessed and published bythe Vehicle Manufacturer. This will include, but is not limited to, television and radio advertisements, vehicle brochures and online information, i.e. the Vehicle Manufacturer website (search to include model and feature specific within the website and using the “buildyour vehicle” service).

Marketing material may not imply that the system offers a higher level of assistance than is provided. Examples of this include descriptions of the system as an automated system, a pilotor self-driving. Images of the driver with hands not touching the steering wheel or performingsecondary tasks over and above those permitted during normal driving, whilst the vehicle is inmotion, are another example.

Any feature describing higher function but clearly labelled as either “future tech” or “not available in this region” or similar is allowed unless deliberately misleading i.e. use of the function as a header.

In case marketing material correctly describes the system functionality, 5 points are awarded.When one or more violations are found, no points are scored.

2.1.3 Quick Start Guide

To be considered a “Quick Start Guide”, information shall be supplied to the consumer on thebasic operation of the driving assistance system and system limits. This shall be in a form supplementary to

the vehicle handbook. The Quick Start Guide may be accessed on a smartphone and/or tablet and may come in different formats:

- Paper format
- Paperless/digital format
- Tutorial video/animation/interactive experience

The Quick Start Guide shall indicate position and function of controls, usage guidelines and system limitations. Where a “Quick Start Guide” is available that meets the requirements, 3 points are scored.

If the tutorial video/animation/interactive experience containing this information can be broadcasted through the vehicle infotainment system, 2 additional points will be awarded.

If a Vehicle Manufacturer has another means by which to supply the information to the consumer, they shall liaise with the test laboratory and the Euro NCAP secretariat who will assess whether it meets the requirements.

2.1.4 Vehicle Handbook

The vehicle handbook shall make it clear to the consumer that the system is an assistance system, and that driver engagement is always required. The handbook shall detail operationof the system and controls. The handbook shall detail intended use of the system and limitsof the systems operation.

In case the vehicle handbook clearly described the system and its limitations, 5 points are awarded.

2.2 System Status

System status	Total points 25
Continuous system status indicator	**20**
System status change indicator	**5**

This assessment is designed to evaluate the information supplied to the driver on a continuousbasis, confirming the level of driving assistance being provided by the system. This is anticipated to be visual information only.

This assessment is also designed to evaluate the information supplied to the driver in case the level of assistance by the system changes. This is anticipated to be:

- Visual information only (in case the level of assistance increases).
- Visual information and audible or haptic warnings (in case the level of assistance decreases).

If a manufacturer has a different method of system status indication to the driver, applied either continuously or momentarily at a change of assistance, the manufacturer shall liaise with the test laboratory and the Euro NCAP secretariat who will consider if and how the system status indicator can be included in the assessment.

2.2.1 Preconditions

To be eligible for points in the System Status assessment, the following preconditions shall be met:

- All system status indicators shall be fitted to the vehicle as part of the assistance system.
- It shall not be possible for the assistance system to be used with the primary indicator disabled by the driver. This applies to visual, audible or haptic indicator related to the system

2.2.2 Continuous System Status Indicator Assessment

The vehicle shall be driven in the following modes to assess whether the Continuous System Status Indicator requirements are met:

- Manual mode (stand-by, no assistance)
- Longitudinal control only (e.g. ACC)
- Longitudinal and Lateral Control in combination.

If a system requires certain parameters for a level of assistance, the test laboratory shall, within reason, meet those requirements.

There is a total of 20 available points in this assessment, distributed as follows:

Continuous System Status Indicator requirements	Manual mode (stand-by, no assistance)	Longitudinal control only (e.g. ACC)	Longitudinal and Lateral Control in combination.	Vehicle ahead
Visual indicator located on the driver's vertical line of sight (i.e., instrument cluster, head-up display)	2.5	2.5	2.5	2.5
Indicated at all times (Always-on)	1.25	1.25	1.25	1.25
Green used for Assisted Mode	-	2.5	2.5	-

2.2.3 System Status Change Indicator Assessment

Euro NCAP does not specify how each change in system status should be achieved, as the conditions required can vary from vehicle to vehicle. The test laboratory shall conduct an on-road evaluation to verify that the requirements of the system to achieve each change in system status are met, where possible without conducting manoeuvres largely different from normal driving. It is required that the test driver remains attentive throughout the transition, so changes in assistance given due to driver monitoring are not accepted as they are assessed elsewhere.

For each of the following transitions between levels of assistance being provided to the driver,record through which means the system indicates to the driver that the transition is taking place.

There is a total of 5 available points in this assessment:

- A total of 2.5 points are awarded when the primary status indicator changes upon an increase or decrease in the level of assistance.
- 2.5 points are awarded when the system prompts a noticeable haptic indication or an additional acoustic indication upon a decrease in the level of assistance. The acoustic indication shall not startle or annoy the driver (50~90 dB recommended).

Assistance change (automatically initiated by System)	Scenario / Cause(s)	Change in primary status indicator	Noticeable haptic indication if driver is driving "hands-on" OR Additional acoustic indication if driver is driving "hands-off" (50~90 dB)
Longitudinal + Lateral ➔Longitudinal only OR No assistance	Unfavourable environmental conditions, sensor blockage, sensor failure	1.25	2.5
No assistance ➔Lateral only OR Longitudinal only ➔ Longitudinal + Lateral	Favourable environmental conditions	1.25	N/A

2.3 Driver Monitoring

Driver Monitoring	Total points 25
Hands-on Monitoring	**5**
Transient Driver States	**20***
Long distraction	6
Short distraction	6
Phone use	8
System lock-out (bonus)	4

*capped

The systems being tested are those that can be broadly grouped together as Assisted Driving systems as defined by Euro NCAP, or as SAE Level 2. This means that the driver retains full responsibility and shares control with the vehicle. Both vehicle and driver share OEDR and thedriver should not perform any secondary tasks over and above those permitted during normal driving.

2.3.1 Hands-on Monitoring

A total of 5 points are available for systems that can robustly detect whether the driver hands are on the steering wheel during Assisted Mode. Systems relying only on torque inputs on the steering wheel are not eligible for Hands-on Monitoring points.

2.3.2 Transient Driver States

DSM systems that monitor driver visual distraction are eligible of scoring a maximum of 20 points, provided that the preconditions listed in 2.3.2.1 are met.

2.3.2.1 Preconditions

- The DSM system shall be offered as an integral part of the Assisted Driving system,
- The DSM system shall meet the requirements of Noise Variables in accordance with the Driver Engagement protocol.
- It shall not be possible to activate Assisted Mode if the DSM is not available due to a complete blockage or system malfunction,
- The Assisted Driving system shall be deactivated no later than 10 seconds from the point the DSM becomes unavailable due to a complete blockage or system malfunction, and it shall not be possible to activate it again until the DSM becomes available,
- The activation of Assisted Mode shall force the activation of DSM if the latter was turned OFF whilst in Manual mode,
- During Assisted Mode operation, the DSM shall be functional in the same Transient and Non-Transient driver states claimed functional in Manual mode (except Impairment).
- The DSM system shall detect and classify a driver as distracted in accordance to the Transient Driver States chapter of the Driver Engagement protocol. This includes Long Distraction, Short

Distraction (VATS) and Phone Use (where the DSM offers detection performance). Only the Non-Driving task Glance Target Types are considered in this assessment.

2.3.2.2 Vehicle response requirements

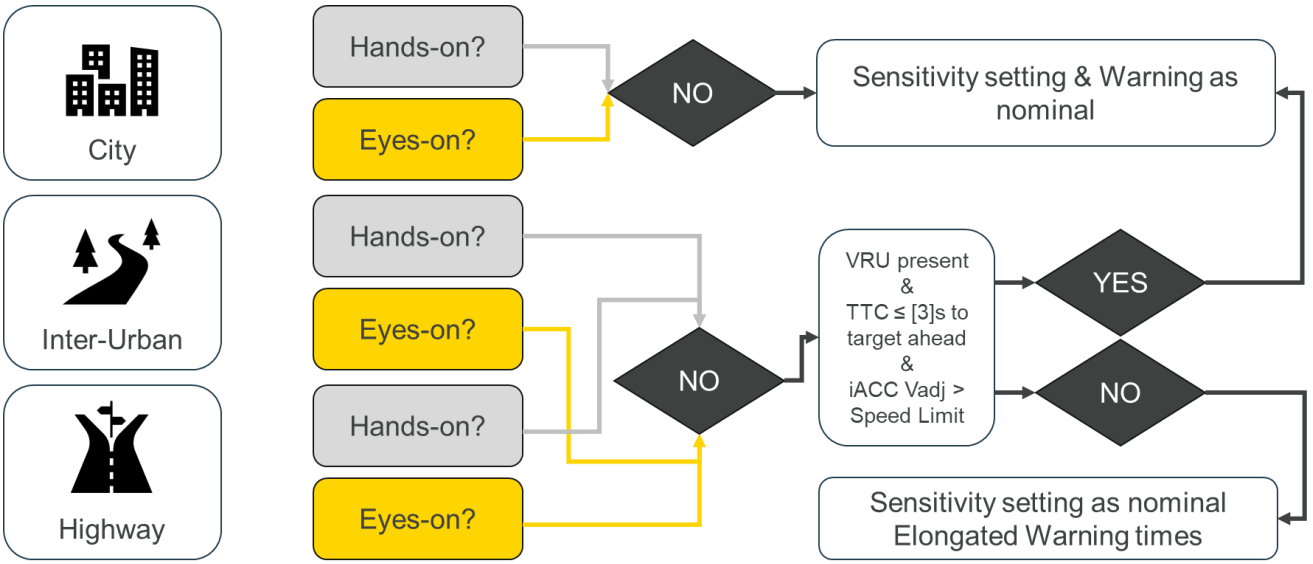
The vehicle responses rewarded in this assessment once the driver has been classified as distracted are warning and intervention.

- Warnings, which shall be visual and/or acoustic/haptic.
- Intervention, which shall be specific to the operation mode of ACC and/or LC and/or LCA function(s), and are demonstrated to have a safety benefit.

The Vehicle Manufacturer may incorporate context-based vehicle response strategies specific for Assisted Driving mode, provided that the following conditions are met:

- Long distraction warning timing thresholds shall not be relaxed by more than 150% (e.g., maximum of 4,5s. for a 3s. baseline case),
- The DSM distraction warning strategy shall be ODD-dependent (i.e., VRU ahead, vehicle set speed and/or TTC of vehicles around),
- The DSM distraction warning strategy while in Assisted Mode shall be the same as in manual mode in at least one of the designated ODD(s) where driver engagement is deemed critical (e.g., complex traffic situations).

As a guideline, an acceptable implementation of distraction warning sensitivity changes is illustrated below:



2.3.2.3 Assessment

The Vehicle Manufacturer shall provide a DSM dossier in accordance with the requirements outlined in the Driver Engagement protocol, adding the specific implementation of the DSM system as part of the Assisted Driving system, including but not limited to:

- Predicted score

- Description of the specific DSM strategies for Assisted Mode regarding detection timing and vehicle response
- Additional strategies not mentioned in this protocol claimed to keep the driver engaged, and evidence of their effectiveness.

The test laboratory shall carry out a spot check of the specific DSM claimed performance regarding detection timing and vehicle response.

The total 20 points are distributed amongst the following cases:

Distraction Type	Distraction Scenario	Movement Type	Warning	Intervention	Sub-total (capped)	Total
Long Distraction	Away from forward road / non-driving task	Owl	1.5	1.5	2	6
		Lizard	1.5	1.5	2	
		Body Lean	1.5	1.5	2	
Short Distraction (VATS)	Away from forward road / non-driving task	Owl	1.5	1.5	2	6
		Lizard	1.5	1.5	2	
	Away from road (multi-location)	Lizard	1.5	1.5	2	
Phone use	Phone Use Detection - Basic	Owl + Lizard	3	3	4	8
	Phone Use Detection – Advanced	Lizard	3	3	4	

In addition, a total of 4 points shall be awarded for systems that incorporate a strategy that prevents the driver to keep using the Assisted Mode after repetitive driver disengagement. The Assisted Mode shall be locked-out in a controllable manner for the remainder of the journey after [3] repetitive (visual) distraction instances in a time window not greater than [15] minutes. The strategy shall apply to all non-driving related distraction types where the system offers functionality (i.e., Long Distraction, VATS, Phone Use). Note that the total score is always capped to 20 points.

2.4 Driving Collaboration

Driving Collaboration	Total points 25
Override torque	**5**
Override response	**20**

This assessment determines how the vehicle responds to a driver steering input (without using the turning indicator), for example to avoid an obstacle within the lane of travel, when the steering assistance system is engaged.

2.4.1 Pothole Test

A direct steering torque measurement system is to be used in these tests, where all torque measurement data shall have a [12-pole phaseless Butterworth filter with a cut off frequencyof 10Hz] filter applied before maximum values are taken.

2.4.1.1 System On

Drive the VUT into a fully marked, 3.5m wide lane at an indicated 45mph (72km/h), using the ACC systemwith the continuous steering assistance system switched ON, and all other default-ON lateral support systems turned ON where possible. Activate the continuous steering assist system and allow the system to take up a consistent position within the lane.

- Apply a full sine wave of steering angle to the VUT steering wheel, with a frequency of 0.25Hz and a steering amplitude resulting in a DTLE = +15 ±5cm.
- Record the maximum/peak steering torque required during the first half of the sinewave.
- Repeat the test three times and record the average maximum steering torque over the three runs.

2.4.1.2 System Off

Drive the VUT down the centre of a fully marked, 3.5m wide lane at an indicated 45mph (72km/h)using the ACC system with the continuous steering assistance system switched OFF, maintaina constant speed and central position within the lane.

- Apply a full sine wave of steering angle to the VUT steering wheel, with a frequency of 0.25Hz and a steering amplitude resulting in a DTLE = 15cm ±5cm.
- Record the maximum/peak steering torque required during the first half of the sinewave.
- Repeat the test three times and record the average maximum steering torque over the three runs.

Both the increase in steering torque and override response are assessed based on the measurements and behaviour in the pothole test.

2.4.2 Partial Lane Change Test

Follow the procedure of Pothole Test, but with a steering amplitude resulting in a DTLE = -50±5 cm, and measure the increase in steering torque and override response.

2.4.3 Override torque

The percentage increase in steering torque between system OFF and system ON is compared:

Increase In Steering Torque	Pothole / Partial Lane Change Test				
	System Torque ≤2.5 Nm	System Torque >2.5 Nm			
		0-33%	33-67%	67%-100%	100%+
	5 points	5 points	3 points	1 point	0 points

2.4.4 Override response

For vehicles where the absolute override torque with system ON <5Nm, a total of 20 points are awarded for the reaction of the system if the following conditions are met:

- The system provides continuous steering assistance throughout the pothole manoeuvre.
- The system may suppress steering assistance during the partial lane change manoeuvre but automatically resumes continuous steering assistance after the vehicle is back in the original lane.
- The system shall suppress steering assistance when conducting a full lane change manoeuvre and automatically resumes continuous steering assistance after the vehicle is in the adjacent lane.

3 ASSISTANCE COMPETENCE - VEHICLE ASSISTANCE

Assistance Competence – Vehicle Assistance	Total points 100
Speed Assistance	**25**
Speed Assist System assessment	20
Reaction to speed limit changes	5
Adaptive Cruise Control performance	**45**
Car-to-Car	18
Car-to-PTW	15
Car-to-VRU	6
Road Features	3
Auto Resume	3
Steering Assistance	**30**
Steering Assistance	24
Lane Change Assist	6

3.1 Speed Assistance

Speed Assistance	Total points 25
Speed Assist System assessment	**20**
Reaction to speed limit changes	**5**

Using the camera and/or map data, vehicles can adopt the prevailing speed limit into the ACC system and/or display the speed limit for information or adoption by a secondary confirmation by the driver. A system with the capability to self-adjust or offer changes of the set speed can be referred to as iACC (intelligent Adaptive Cruise Control).

The VUT results of the Euro NCAP Speed Assist Systems assessment is used as basis and tests are to be performed as per the Vehicle Assistance protocol – Speed Assistance. Additionally, the VUT is assessed for its ability to recognise a change in speed limit and apply or offer that change in speed to the ACC.

3.1.1 Speed Assist Systems assessment

If a vehicle is presented for assisted driving assessment and has not already been through the Euro NCAP rating scheme, it is a requirement to carry out the Speed Assistance System tests as partof this assessment, following Euro NCAP Speed Assist Systems assessment as detailed in the Vehicle Assistance protocol.

For the Highway and Interurban Assist assessment, the normal Speed Assistance score is directly carried over.

3.1.2 Reaction to speed limit changes

5 Points are available when vehicle starts adjusting the iACC set speed when passing a speed limit change.

The Vehicle Manufacturer shall provide the test laboratory and the Euro NCAP secretariat with information showing the vehicle response to speed limit changes for:

- Fixed speed limits
- Variable and temporary speed limits

The Vehicle Manufacturer shall take the following into account when providing the information:

- Systems that automatically adjust the speed to the desired speed limit shall be deemed to have adopted the speed limit in time if the vehicle starts slowing down before the front axle of the vehicle passes the sign.
- Systems which offer adjustment to the new speed limit but require a manual action from the driver shall be deemed to have adopted the speed limit in time if the vehicle starts slowing down before the front axle of the vehicle passes the sign when the driver gives the confirmation action 1.5 seconds afterthe lower limit is offered.
- A system which only provides information about upcoming and current speed limits shall be deemed to have provided the information in time if the lower speed limit information is displayed to the driver at a time which allows the driver to manually setthe ACC to the lower speed limit and the vehicle starts slowing down before the front axle of the vehicle passes the sign, when the driver starts this process 1.5 seconds after the information is given.

The test laboratory shall verify that the iACC adjusts the speed as indicated by the Vehicle Manufacturer, as part of the Vehicle Assistance on-road evaluation.

3.2 Adaptive Cruise Control Performance

The assessment of Adaptive Cruise Control Performance shall be conducted as outlined in the Vehicle Assistance protocol. The scores are scaled as indicated below:

ACC Performance	Total points 45
Car-to-car	**18**
Longitudinal	12
Cut-in / Cut-out	6
Car-to-PTW	**15**
Longitudinal	12
Cut-in / Cut-out	3
Car-to-VRU	**6**
Longitudinal	6
Road Features	**3**
Auto-resume	**3**

3.2.1 Car-to-car

Car-to-car	Total points 18
Longitudinal	**12**
CCRs straight	3
CCRs curve	3
CCRm	3
CCRb	3
Cut-in / Cut-out	**6**
Cut-in	3
Cut-out	3

3.2.2 Car-to-PTW

Car-to-PTW	Total points 15
Longitudinal	**12**
CMRs straight	3
CMRs curve	3
CMRm	3
CMRb	3
Cut-in / Cut-out	**3**
Cut-in	1.5
Cut-out	1.5

3.2.3 Car-to-VRU

Car-to-VRU	Total points 6
Longitudinal	**6**
CPLA-0	3
CBLA-0	3

3.2.4 Road Features

Road Features	Total Points 3
Curves	0.6
Roundabouts	0.6
Intersection, no right-of-way	0.6
Traffic lights	0.6
Stop signs	0.6

3.2.5 Auto-Resume

ACC Auto-Resume	Total Points 3
Automatic resume	**3**
Driver input	**1.5**

3.3 Steering Assistance

The assessment of Steering Assistance shall be conducted as outlined in the Vehicle Assistance protocol. The scores are scaled as indicated below:

Steering Assistance Performance	Total points 30
Steering Assistance	**24**
Lane Change Assist	**6**

4 SAFETY BACKUP

Safety Backup	Total points 100
System Failure	**25**
Sensor blocked at start-up	10
Sensor blocked with VUT in motion, system inactive	5
Sensor blocked with VUT in motion, system active	10
Non-transient driver states	**25**
Microsleep	5
Sleep	5
Unresponsive driver	15
Collision Avoidance	**50**
Car-to-car	10
Car-to-PTW	10
Car-to-VRU	5
Lane Support System	25

4.1 System Failure

In real world driving, it is anticipated that the sensors involved with the Driver Assistance System (Radar, LiDAR, or camera) may either deteriorate by age or damage or become blockedin adverse environmental conditions. Having a blocked or deteriorated sensor may reduce the competency of the system. It is important that the system does not operate with reduced competency and that the driver is aware of the reason that the system becomes unavailable.

It is believed that all current systems may see some reduction in competency when a sensor fails, but there may be redundancy built into the system or multi-function sensors used to mitigate the effects to the performance of the system if a single sensor fails.

4.1.1 Pre-Test

Due to the complex nature of current systems and sensors the Vehicle Manufacturer shall fill in a questionnaire prior to the test taking place to detail the anticipated effect of blocking the sensors involved in providing the assistance in relation to each system.

4.1.2 Test

The test shall assess all individual sensors systematically in three different scenarios:

- Sensor blocked at vehicle start up.
- Sensor becomes blocked when vehicle is moving but Driver Assistance System notactivated.
- Sensor becomes blocked when vehicle is moving with the Driver Assistance Systemactive and engaged.

For each sensor that forms part of the assistance system, the assessment is the same. The total points will then equally distributed amongst the considered sensors. For camera and/or lidar sensor(s) involved in the Driver Assistance System, the assessment shall be repeated with vertical partial coverage, either by blocking half of the effective field of view of the camera/lidar or by fully blocking one of the lenses of a stereo camera (in any case, either left side or right side shall be randomly selected). For sensor location/design for which the field of view cannot easily be determined, the Vehicle Manufacturer may advise the test laboratory on the positioning of the blocking material" (i.e., Vehicle Manufacturer to support with in-house data).

The sensors shall be blocked in accordance with the Technical Bulletin: *"TB 041 - AD Sensor Blocking"*

4.1.2.1 Sensor Blocked at Start-up

With the VUT switched off, cover the sensor under test with a material that shall prevent the sensor receiving a signal (e.g., radar absorbing material is typically used to cover the radar).

Once the material is in place start the car and drive up to the minimum speed to activate the assistance system as detailed in the vehicle handbook. If the assistance system can't be engaged after a 2 minute drive, then the VUT scores 8 points and is eligible for a further 2 points if a visual warning is displayed within 5 minutes of driving above the minimum speed following this activation attempt. If the control system can be activated at this time the VUT scores 0 points.

4.1.2.2 Sensor Blocked with VUT in motion, System not active

Drive the VUT with the assistance system not activated at the minimum speed [or 30km/h minimum speed, whichever is lowest] required to activate the system for 1 minute. Then, without slowing below this speed, cover the sensor with the same material that was used in the above test and attempt a system activation after 2 minutes.

If the system cannot be engaged, then the VUT scores 4 points and is eligible for a further 1 point if a visual warning is displayed within 5 minutes of driving above the minimum speed following this activation attempt. If the assistance system can be activated at this time, the VUTscores 0 points.

4.1.2.3 Sensor Blocked with VUT in motion, System active

Drive the VUT with the assistance system activated at the minimum design speed for the system [or 30km/h minimum speed, whichever is lowest]. Then, without stopping, cover the sensor with the same material that was used in the above test.

If the system cancels within 2 minutes of the material covering the sensor then the VUT scores8 points and is eligible for a further 2 points if a visual warning is displayed within 5 minutes of driving following the covering of the sensor. Any other time before the system cancels willscore 0 points.

If the Vehicle Manufacturer has declared that the system suffers no loss in performance when a sensor is blocked, then, with that sensor covered, the test laboratory shall confirm this by repeating, either

- the CCRs test from ACC Performance at highest speed that was avoided by the VUTin case the sensor becoming blocked is declared to have no effect on longitudinal control.
- the Steering Assistance test at the highest speed that the VUT remained in lane, in case the blocked sensor is declared to have no detriment to lane guidance. If the vehicle does not remain in lane at any of the test speeds, repeat the 80km/h test andaccept a deviation no greater than 0.25m from the original path.

If the Vehicle Manufacturer declaration is confirmed by this/these test(s), the VUT scores 20 of the available points for this sensor. It shall then provide a visual message to the driver that the sensor has become blocked, this can be at any time but shall be displayed no later than the beginning ofthe next drive as defined by an ignition cycle, the display of the visual message scores the VUTan additional 5 points for this sensor and it is added to the total score equation in section 3.

If the VUT fails the confirmation test, then 0 points are scored for that sensor.

4.2 Non-Transient Driver States

Non-Transient Driver States	Total points 25
Microsleep	**5**
Sleep	**5**
Unresponsive Driver	**15**
Direct sensing	10
Indirect sensing	10
Target stop area	5

This assessment is intended to evaluate the vehicle response upon the detection of the following non-transient driver states:

- Microsleep
- Sleep
- Unresponsiveness

4.2.1 Microsleep

5 points are awarded for systems able to provide an visual + acoustic/haptic warning AND increase the ACC time headway (and/or other intervention strategies with demonstrated safety benefit) immediately after the driver state is classified as ‘microsleep’ (following the sleep detection requirements outlined in the Driver Engagement protocol) The Vehicle Manufacturer shall describe in detail the vehicle response in a dossier.

4.2.2 Sleep

5 points are awarded for systems able to provide an visual + acoustic/haptic warning AND increase the ACC time headway (and/or other intervention strategies with demonstrated safety benefit) immediately after the driver state is classified as ‘sleep’ (following the sleep detection requirements outlined in the Driver Engagement protocol) The Vehicle Manufacturer shall describe in detail the vehicle response in a dossier.

4.2.3 Unresponsive Driver

For Unresponsive Driver, 10 points are awarded when the detection is enabled by indirect inputs (e.g., prolonged steering inactivity), and 10 points are also awarded when the detection is enabled by DSM (i.e., as outlined in the Driver Engagement protocol). In both cases, the vehicle response shall be an Emergency Function immediately initiated after the driver is classified as unresponsive, that maintains steering control and brings the vehicle to a controlled stop or reduces its speed to crawling speed. An additional 5 points are reserved for a more advanced response in case of an unresponsive driver:

- Lane change in direction towards slowest lane (1 lane): +3 points
- Lane change to the slowest lane (up to 2 lanes) : +4 Points
- Lane change to emergency lane (or breakdown spot): +5 points

4.2.3.1 Test procedure for Direct sensing

When the system offers Unresponsive Driver intervention enabled by Direct sensing, follow the test procedure as outlined in TB 039.

4.2.3.2 Test procedure for Indirect sensing 80km/h Test

When the system offers Unresponsive Driver intervention enabled by Indirect sensing, the so-called 80 km/h test is to be conducted to verify performance. This test shall be performed in a minimum two-lane straight road with a length of adequate length not including acceleration and braking zones. The near side most lane shall have a solid white line with enough space for a safe harbour (hard shoulder or none running lane) across from the driving lanes.

For geo-fenced systems, it is permissible and recommended that the Vehicle Manufacturer has the test labs test track assigned as a highway on their test vehicle.

Affix onboard cameras to monitor the Instrumentation of the vehicle at the minimum and it is recommended to mount at least one additional camera monitoring the interior / driver cockpit.

With no other vehicles on the track, and the VUT in the second driving lane, accelerate up to test speed and engage ACC and continuous steering assistance system.

Allow the system to take up a consistent position within the lane and then release the controls “hands off”. For ease of video review, use a trigger such as saying the phrase “hands off” at the moment of releasing the steering wheel.

Where direct DSM system is able to classify driver as unresponsive, follow the test execution as outlined in TB 039, (with specific provisions adapted to the specific DSM system strategy).

Observe and if required make verbal comments on the vehicle’s response. The test is considered complete when either:

- The vehicle comes to a complete stop.
- The warning escalation ends.
- Both the longitudinal and steering assistance systems switch off.
- There is no response from the car and the test driver has to stop at the end of the test track section.

4.3 Collision Avoidance

The aim of the Collision Avoidance assessment is to assess only how the longitudinal assist system fitted to the vehicle reacts to other road users during operation, although avoidance by in-lane steering manoeuvre is also permissible in critical situations where avoidance by braking is not possible. The system shall be assessed for performance when driving on typical highway and interurban situations. The “Collision Avoidance” assessment will look at the capability of the vehicle to avoid Car-to-Car, Car-to-PTW, and Car-to-VRU collisions using both assisted driving systems and emergency systems combined.

The Vehicle Manufacturer is required to provide the Euro NCAP Secretariat with colour data detailing the predicted performance of the vehicle in all the Collision Avoidance scenarios, for all speed combinations (expected impact speeds are not required). Furthermore, the expected FCW timing in TTC [s] is to be provided for scenarios where full avoidance is not achieved. All data shall be supplied by the manufacturer before any testing begins, preferably with delivery of the test vehicle(s). The colour data with predicted performance shall be in accordance with the table below:

Colour		Expected CA performance
Green	Car-to-Car	Full avoidance
	Car-to-PTW	Full avoidance
	Car-to-VRU	Full avoidance
Orange	Car-to-Car	Speed reduction > 30 km/h
	Car-to- PTW	Speed reduction > 30 km/h
Grey	Car-to-Car	Speed reduction ≤ 30 km/h
	Car-to-PTW	Speed reduction ≤ 30 km/h

In case the Vehicle Manufacturer provides performance predictions, the test laboratory will test the same scenarios chosen for ACC performance.

In case the Vehicle manufacturer does not provide performance predictions, the test laboratory will conduct all scenarios.

4.3.1 Car-to-Car

Car-to-car	Sub-points	Points

ACC/AEB CAR-TO-CAR	**40**	**10**
CCRs – Stationary target	8	
CCRs – Stationary target in a curve	8	
CCRm – Moving target	15	
CCRb – Braking target	1	
Cut-in	4	
Cut-out	4	

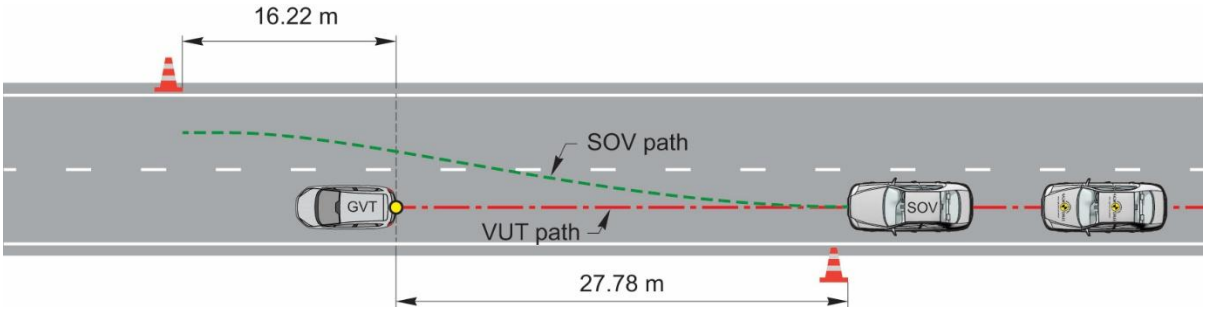
For each scenario and test speed, 1 point can be achieved where the ACC and/or AEB fully avoids the collision. Where the ACC and/or AEB intervenes and reduces the impact speed by more than 30 km/h, 0.5 points are scored. Where the ACC and/or AEB system does not avoid the collision, but an FCW is issued at a TTC >1.5s an additional 0.25 points are awarded for that scenario.

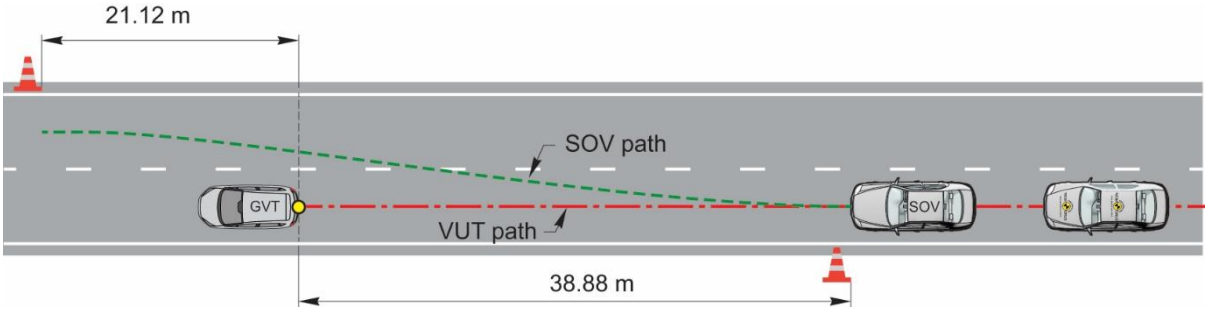
For CCRs, CCRm and CCRb, the same test speeds are used as for the ACC Performance assessment. For Cut-in and Cut-out additional and more critical set-ups are used to verify theSafety Backup.

Cut-in & Cut-out	VUT	GVT/SOV
Cut-in		
Cut-in @ TTC = -1.50	50 km/h	10 km/h
Cut-in @ TTC = 0.50	120 km/h	70 km/h
Cut-out		
Cut-out @ TTC = 2.00	70 km/h	50 km/h
Cut-out @ TTC = 2.00	90 km/h	70 km/h

4.3.1.1 Cut-out tests

The additional Cut-out tests for Safety Back-up shall also be performed using a real car but the lead vehicle shall cut-out at a TTC of 2s instead of 3s as in ACC Performance.




21.12 m
SOV path
GVT
SOV
VUT path
38.88 m

4.3.2 Car-to-PTW

Car-to-PTW	Sub-points	Points
ACC/AEB CAR-TO-PTW	**36**	**10**
CMRs – Stationary target, GVT side	4	
CMRs – Stationary target, GVT front	4	
CMRs – Stationary target in a curve	4	
CMRm – Moving target	15	
CMRb – Braking target	1	
Cut-in	4	
Cut-out	4	

For each scenario and test speed, 1 point can be achieved where the ACC and/or AEB fully avoids the collision. Where the ACC and/or AEB intervenes and reduces the impact speed by more than 30 km/h (for relative speeds >30 km/h), 0.5 points are scored. Where the ACC and/or AEB system does not avoid the collision, but an FCW is issued at a TTC >1.5s an additional 0.25 points are awarded for that scenario.

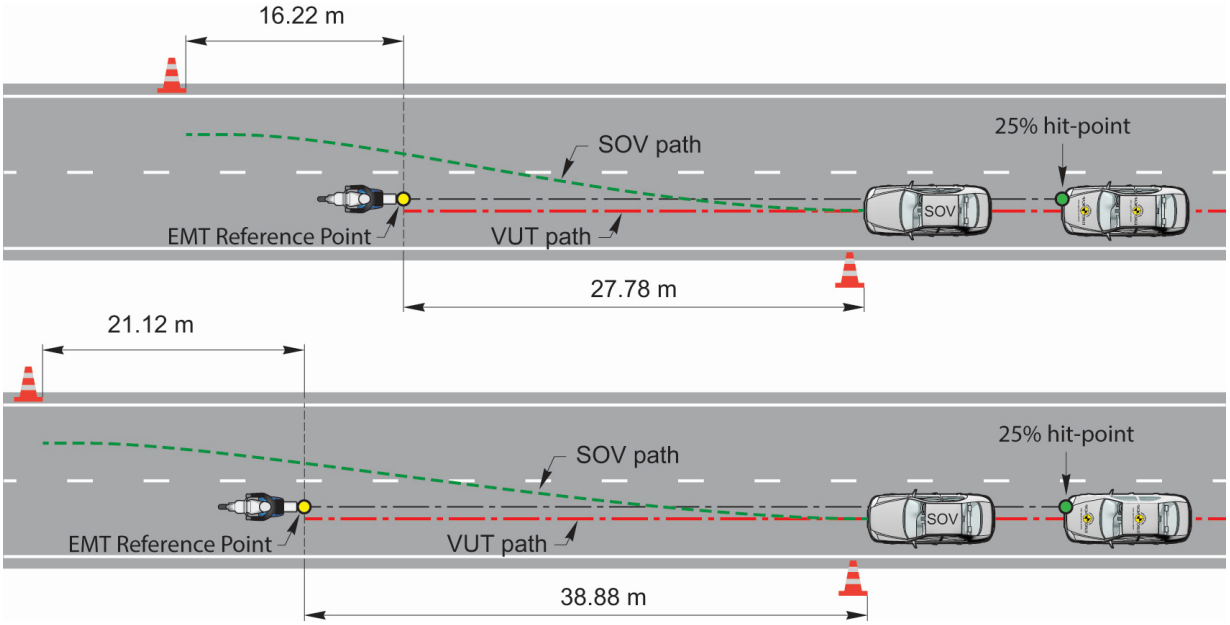
Where the Vehicle Manufacturer can either demonstrate or show substantial evidence that the ACC and/or AEB intervenes and reduces the impact speed by more than 30 km/h (for relative speeds >30 km/h), 0.5 points are scored.

For CMRs, CMRm and CMRb, the same test speeds are used as for the ACC Performance assessment. For Cut-in and Cut-out additional and more critical set-ups are used to verify theSafety Backup. The EMT boundary conditions defined for Cut-in are the same as in the ACC Performance assessment.

Cut-in & Cut-out	VUT	EMT/SOV
Cut-in		
Cut-in @ TTC = -1.00	50 km/h	10 km/h
Cut-in @ TTC = 0.75	120 km/h	70 km/h
Cut-out		
Cut-out @ TTC = 2.00	70 km/h	50 km/h
Cut-out @ TTC = 2.00	90 km/h	70 km/h

4.3.2.1 Cut-out tests

The additional Cut-out tests for Safety Back-up shall also be performed using a real car but the lead vehicle shall cut-out at a TTC of 2s instead of 3s as in ACC Performance.



4.3.3 Car-to-VRU

Car-to-VRU	Sub-points	Points
ACC/AEB CAR-TO-BICYCLIST/PEDESTRIAN	**8**	**5**
CBLA-0	4	
CPLA-0	4	

This assessment looks at the capability of the vehicle to avoid a collision, using both assisted driving systems and emergency systems combined.

For each scenario and test speed, 1 point can be achieved where the ACC and/or AEB/AES fully avoids the collision. Where the ACC and/or AEB/AES system does not avoid the collision, but an FCW is issued at a TTC >1.5s an additional 0.25 points are awarded for that scenario.

In-lane steering manoeuvre is also permissible in critical situations where avoidance by braking is not possible.

Moreover, for the high relative speeds, it is permissible for the Vehicle Manufacturer to implement an early speed reduction strategy linked to an inattentive or unresponsive driver (detected by the DSM).

4.3.4 Lane Support System

Lane Support System	Points
S-Bend	**20**
Lane Change with overtaking vehicle	**5**

4.3.4.1 S-Bend

The lane support system – S-bend is designed to determine the ability of the vehicle to stay inlane or alert the driver to a lane departure on a curved section of road using both the AD system and the emergency LSS systems such as ELK, LKA and LDW.

This section is based on the same test scenarios and test speeds as the Steering Assistance section. For each test speed at which the vehicle remained in lane during the Steering Assistance assessment, the points for Collision Avoidance are automatically awarded.

For each test speed at which the vehicle did not remain in lane during steering assistance tests,repeat the test, as per Steering Assistance with all additional LSS systems switched on.

Where an LKA intervention prevents the VUT from crossing the lane marking by more than 0.4m, 5 points are awarded. Where there is no intervention by the system, but an audible or haptic LDW is provided before the vehicle has left the lane by more than 0.3m, 2.5 points are scored.

4.3.4.2 Lane change with overtaking vehicle

The lane change section of the collision avoidance system is to assess the vehicles ability to stop the vehicle changing lane into the path of a vehicle travelling in the adjacent lane. Both ELK systems and Blind Spot Monitoring with active torque systems fitted as part of the driverassistance pack which can change the vehicles heading to prevent a collision are considered beneficial in this scenario.

All the ELK Car-to-Car and Car-to-PTW Overtaking Intentional tests from the Euro NCAP Lane Departure Collisions protocol are to be performed. If the vehicle has already been assessed by Euro NCAP, these resultscan potentially be carried over depending on the fitment of the vehicle tested by Euro NCAP. This may need to be retested with the AD vehicle due to higher fitment resulting is differing performance to the vehicle assessed in the Euro NCAP safety assessment.

A total of 5 points are awarded for intentional lane change tests: 2.5 Points for Car-to-Car and 2.5 points for Car-to-PTW.