EURO NCAP
#FORSAFERCARS

Version 0.9
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Crash Avoidance
Lane Departure Collisions

Protocol

Implementation January 2026

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.

NOTE: All 2026 protocols with a version number 0.9 are under final review of the Working Group and might undergo minor changes

CONTENTS

DEFINITIONS

Throughout this protocol the following terms are used:

Peak Braking Coefficient (PBC) – the measure of tyre to road surface friction based on the maximum deceleration of a rolling tyre, measured using the method as specified in UNECE R13-H.

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 drift beyond a lane boundary (ie. solid lane marking, the edge of the road, etc) or into oncoming or overtaking traffic in the adjacent lane.

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

Vehicle under test (VUT) – means the vehicle tested according to this protocol with an Emergency Lane Keeping, Lane Keep Assist and/or Lane Departure Warning system.

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

Euro NCAP Motorcyclist Target (EMT) – means the Motorcyclist target used in this protocol as specified in 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 target, assuming that the VUT and target would continue to travel with the speed it is travelling.

Standard range – refers to the most basic and controlled format a test scenario will be tested. Tests within the standard range are deemed the foundational level performance expectations for any given test scenario.

Extended range – refers to test points in which minor levels of complexity are introduced to the standard range tests. Changes for this range are limited to lateral or longitudinal velocity variations for the VUT and / or test target.

Robustness layer – refers to the introduction of test complexity and variation, designed to challenge vehicle systems and encourage reliable "real-world" performance.

Lane Edge – means the inner side of the lane marking or the road edge

Distance To Lane Edge (DTLE) – means the remaining lateral distance (perpendicular to the Lane Edge) between the Lane Edge and most outer edge of the tyre, before the VUT crosses Lane Edge, assuming that the VUT would continue to travel with the same lateral velocity towards it.

Driver Intention Monitoring system – means a system that is effective at distinguishing intentional from unintentional lane crossing and suppressing undesired interventions and/or warnings.

1 MEASURING EQUIPMENT

1.1 Reference system

1.1.1 Convention

Use the convention specified in ISO 8855:2011, with the origin at the most forward point on the centreline of the VUT for dynamic data measurements as shown in Figure 1-1. This reference system should be used for both left- and right-hand drive vehicles. In Figure 1-1 nearside and far-side are shown for a left-hand drive vehicle. For a right-hand drive vehicle, nearside and far-side are swapped.

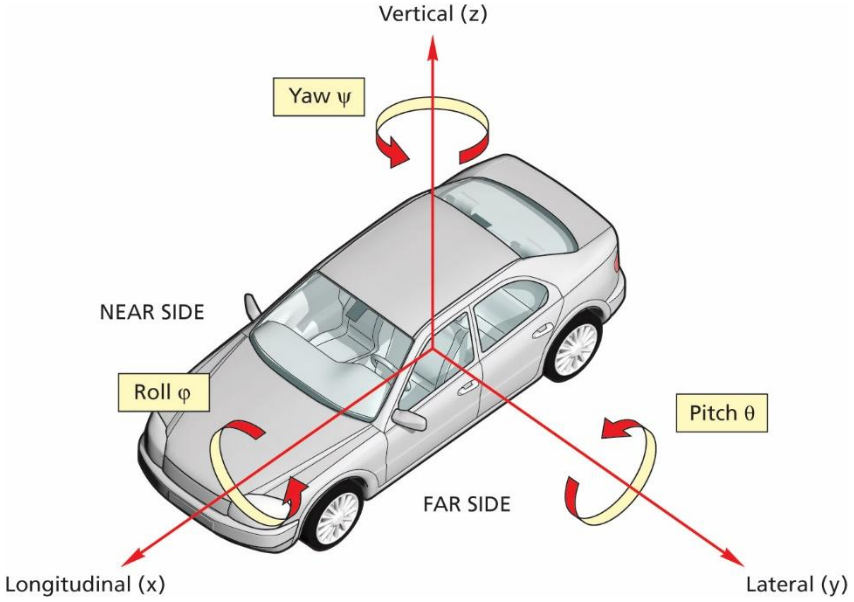
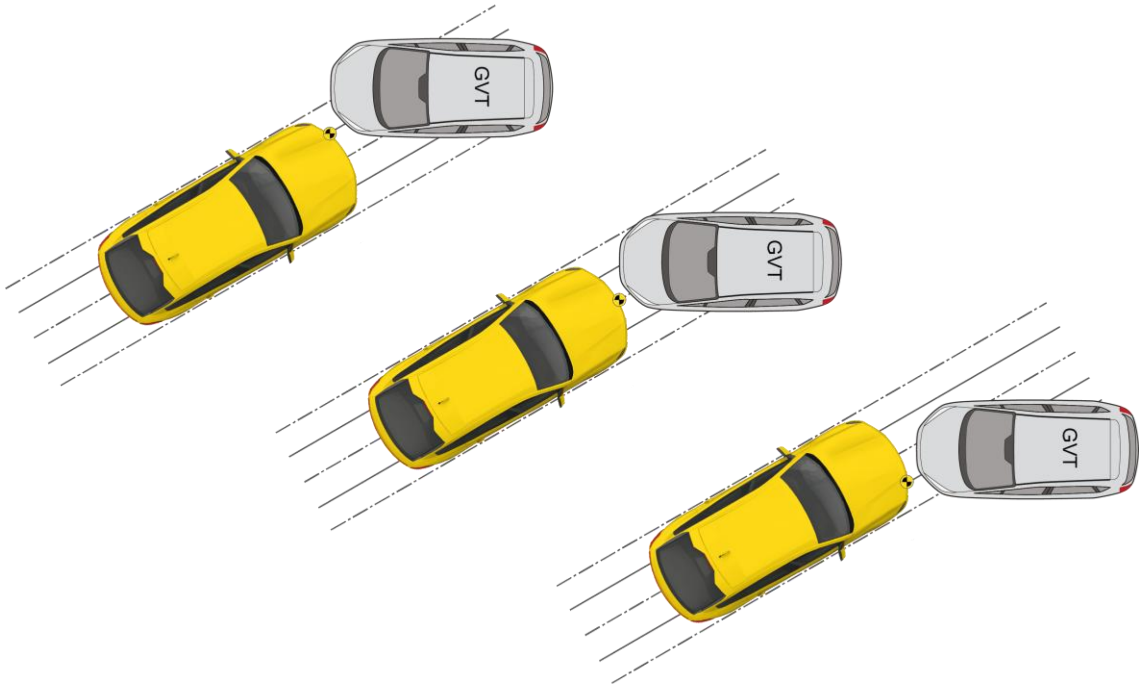


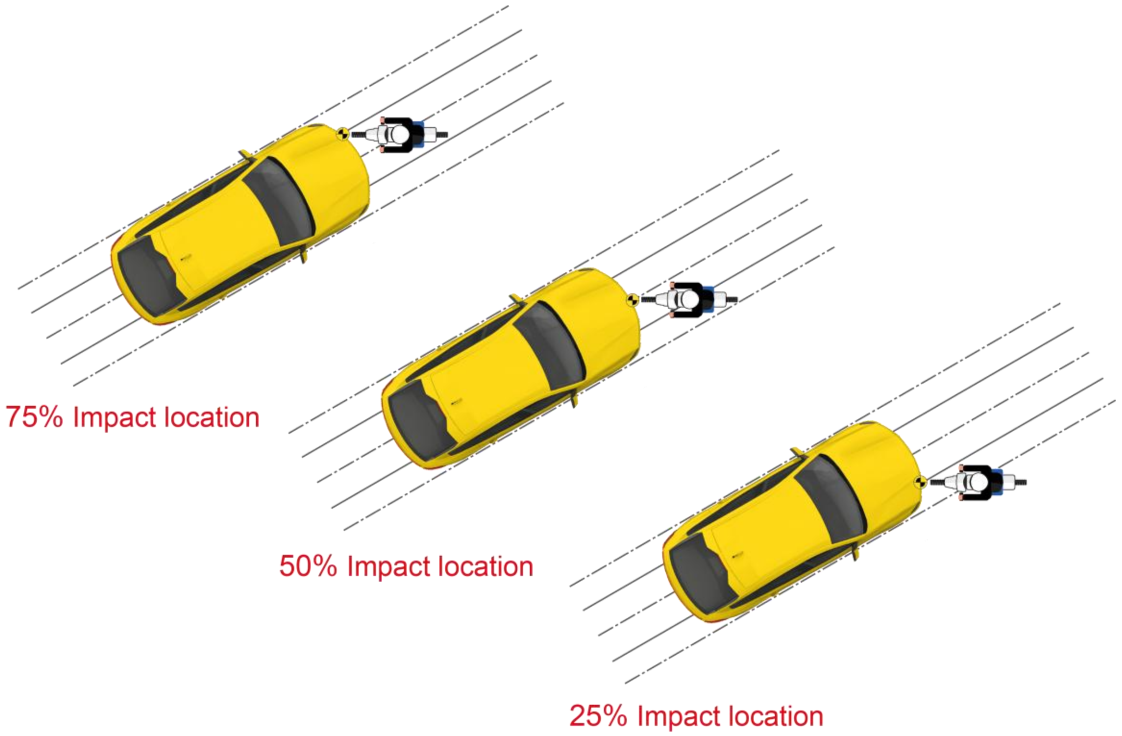
Figure 1-1 Coordinate system and notation

1.1.2 Impact location

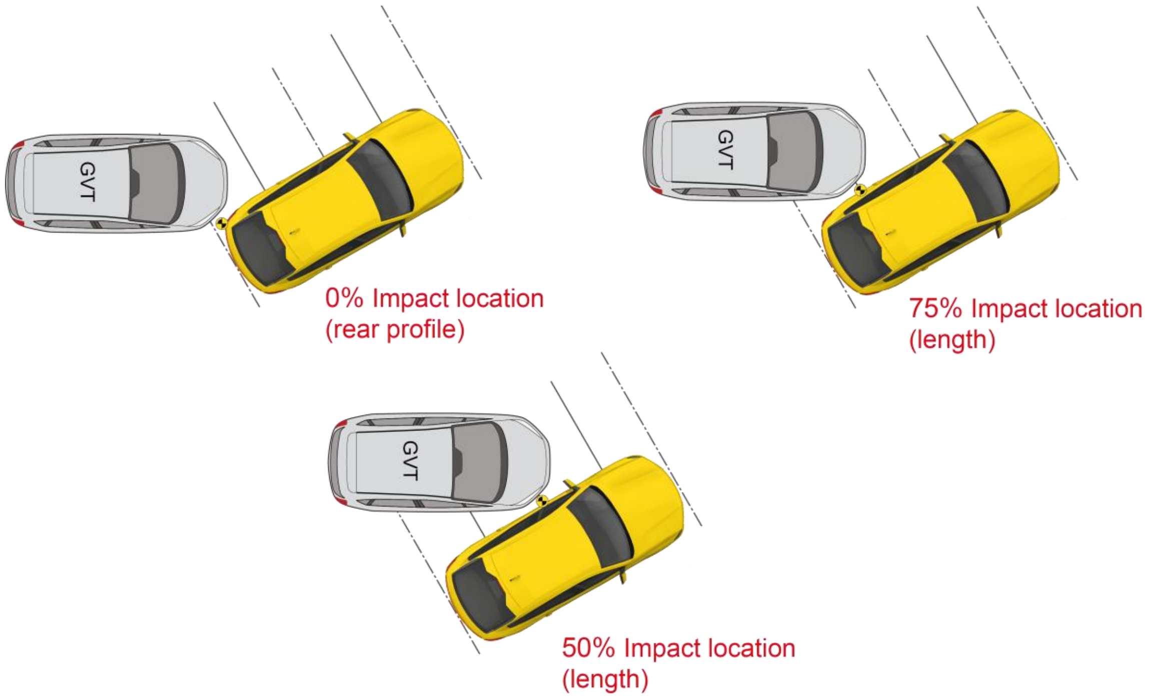
1.1.2.1 Car-to-car Oncoming



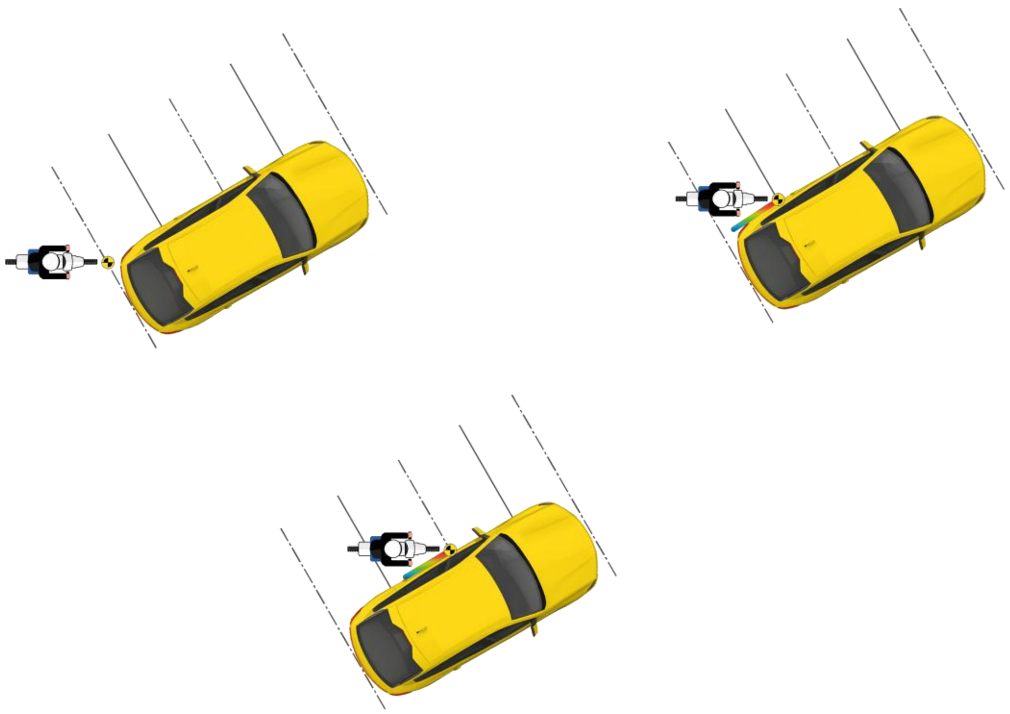
1.1.3 Car-to-Motorcyclist Oncoming



1.1.3.1 Car-to-car Overtaking



1.1.4 Car-to-Motorcyclist Overtaking



1.2 Targets

Only equipment listed in the current version of TB029 - Suppliers List may be used for testing. The current version can be found on the Euro NCAP website.

1.3 Measurements and variables

Sample and record all dynamic data at a frequency of at least 100Hz. Synchronise using the DGPS time stamp the GVT data with that of the VUT.

1.3.1 Variables

Time	**T**
T_0, time where manoeuvre starts with 2s straight path T_{LDW}, time where LDW activates T_{steer}, time where VUT enters in curve segment $T_{crossing}$, time where VUT crosses the line or road edge	$\mathbf{T}_0$ $\mathbf{T}_{LDW}$ $\mathbf{T}_{steer}$ $\mathbf{T}_{crossing}$
Position of the VUT during the entire test	$\mathbf{X}_{VUT}$, $\mathbf{Y}_{VUT}$
Position of the GVT during the entire test	$\mathbf{X}_{GVT}$, $\mathbf{Y}_{GVT}$
Speed of the VUT during the entire test	$\mathbf{V}_{long,VUT}$ $\mathbf{V}_{lat,VUT}$
Speed of the GVT during the entire test	$\mathbf{V}_{GVT}$
Yaw velocity of the VUT during the entire test	$\dot{\Psi}_{VUT}$
Yaw velocity of the GVT during the entire test	$\dot{\Psi}_{GVT}$
Steering wheel velocity of the VUT during the entire test	$\mathbf{\Omega}_{VUT}$

1.3.2 Equipment

Equip the VUT with data measurement and acquisition equipment to sample and record data with an accuracy of at least:

- VUT and target longitudinal speed to 0.1km/h;
- VUT and target lateral and longitudinal position to 0.03m;
- VUT heading angle to 0.1°;
- VUT and target yaw rate to 0.1°/s;
- VUT longitudinal acceleration to 0.1m/s^2;
- VUT steering wheel velocity to 1.0°/s.

1.4 Data Filtering

Filter the measured data as follows:

Position and speed are not filtered and are used in their raw state.

Acceleration, yaw rate, steering wheel torque and steering wheel velocity with a 12-pole phase less Butterworth filter with a cut off frequency of 10Hz.Test conditions

1.5 Test track

Conduct tests on a dry (no visible moisture on the surface), uniform, solid-paved surface with a maximum slope of ±1% in the longitudinal direction and a maximum lateral slope of ±3%.

The test track surface shall have a minimal peak braking coefficient (PBC) of 0.9, must be paved and may not contain any irregularities (e.g. large dips or cracks, manhole covers or reflective studs) within a lateral distance of 3.0m to either side of the centre of the test lane and with a longitudinal distance of 30m ahead of the VUT from the point after the test is complete.

1.5.1 Lane Markings and Road Edge

The tests described in this document require use of two different types of lane markings conforming to one of the lane markings as defined in UNECE Regulation 130 to mark a lane with a width of 3.5 to 3.7m when measured from the inside edge of the lane marking and a road edge:

1. Dashed line with a width between 0.10 and 0.25m (0.10 and 0.15m for centre lines)
2. Solid line with a width between 0.10 and 0.25m
3. Road Edge consisting of grass and/or gravel or any other approved surrogate

The inner edge of the lane marking shall be at 0.20 to 0.30m from the road edge (transition between paved test surface and road edge material), where applicable.

The lane markings and/or road edge should be sufficiently long to ensure that there is at least 20m of marking remaining ahead of the vehicle after the test is complete.

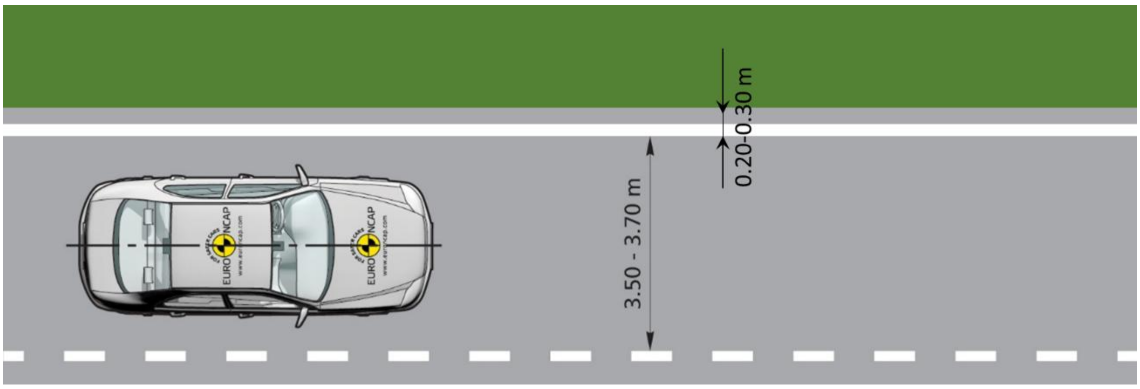


Figure: Layout of the lane markings

1.5.2 Weather conditions

Conduct tests in dry conditions with ambient temperature above 5°C and below 40°C.

No precipitation shall be falling and horizontal visibility at ground level shall be greater than 1km. Wind speeds shall be below 10m/s to minimise VUT disturbance.

Natural ambient illumination must be homogenous in the test area and in excess of 2000 lux for daylight testing with no strong shadows cast across the test area other than those caused by the VUT. Ensure testing is not performed driving towards, or away from the sun when there is direct sunlight.

Measure and record the following parameters preferably at the commencement of every single test or at least every 30 minutes:

a) Ambient temperature in °C;
b) Track Temperature in °C;
c) Wind speed in m/s;
d) Wind direction in azimuth ° and/or compass point direction (monitoring);
e) Ambient illumination in Lux.

1.6 VUT Preparation

1.6.1 System Settings

Set any driver configurable elements of the system (e.g. the timing of the Lane Departure Warning or the Lane Keep Assist if present) to the middle setting or midpoint and then next poorer performing setting similar to the examples shown in Figure 4. Lane Centering functions should be turned OFF. Furthermore, if a vehicle has a system where ELK or ELK + LKA mode can be selected, test the vehicle in ELK + LKA mode.

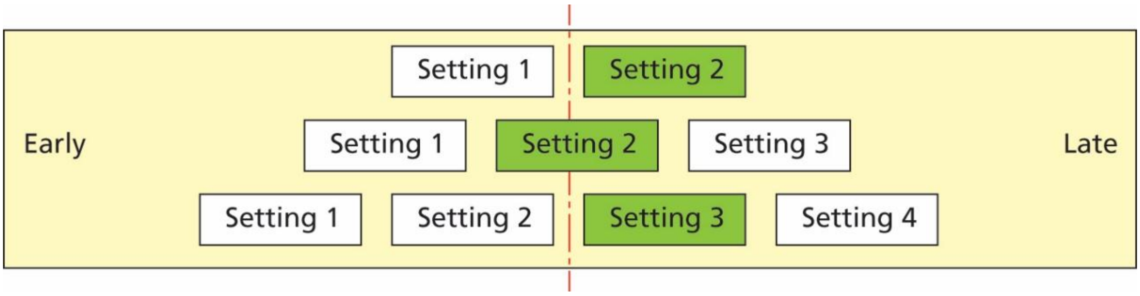


Figure: System setting for testing

1.6.2 Tyres

Perform the testing with new original fitment tyres of the make, model, size, speed and load rating as specified by the vehicle manufacturer. It is permitted to change the tyres which are supplied by the manufacturer or acquired at an official dealer representing the manufacturer if those tyres are identical make, model, size, speed and load rating to the original fitment. Use inflation pressures corresponding to least loading normal condition.

Run-in tyres according to the tyre conditioning procedure. After running-in maintain the run-in tyres in the same position on the vehicle for the duration of the testing.

1.6.3 Wheel Alignment Measurement

The vehicle should be subject to a vehicle (in-line) geometry check to record the wheel alignment set by the OEM. This should be done with the vehicle in kerb weight.

1.6.4 Unladen Kerb Mass

If applicable, fill up the tank with fuel to at least 90% of the tank's capacity of fuel.

Check the oil level and top up to its maximum level if necessary. Similarly, top up the levels of all other fluids to their maximum levels if necessary.

Ensure that the vehicle has its spare wheel on board, if fitted, along with any tools supplied with the vehicle. Nothing else should be in the car.

Ensure that all tyres are inflated according to the manufacturer's instructions for the least loading condition.

Measure the front and rear axle masses and determine the total mass of the vehicle. The total mass is the 'unladen kerb mass' of the vehicle. Record this mass in the test details.

Calculate the required ballast mass, by subtracting the mass of the test driver and test equipment from the required 200 kg interior load.

1.6.5 Vehicle Preparation

Fit the on-board test equipment and instrumentation in the vehicle. Also fit any associated cables, cabling boxes and power sources and place weights with a mass of the ballast mass. Any items added should be securely attached to the car.

With the driver in the vehicle, weigh the front and rear axle loads of the vehicle and compare these loads with the "unladen kerb mass"

The total vehicle mass shall be within ±1% of the sum of the unladen kerb mass, plus 200kg. The front/rear axle load distribution needs to be within 5% of the front/rear axle load distribution of the original unladen kerb mass plus full fuel load. If the vehicle differs from the requirements given in this paragraph, items may be removed or added to the vehicle which has no influence on its performance. Any items added to increase the vehicle mass should be securely attached to the car.

Care needs to be taken when adding or removing weight in order to approximate the original vehicle inertial properties as close as possible. Record the final axle loads in the test details. Record the axle weights of the VUT in the 'as tested' condition.

Vehicle dimensional measurements shall be taken. For purposes of this test procedure, vehicle dimensions shall be represented by a two-dimensional polygon defined by the lateral and longitudinal dimensions relative to the centroid of the vehicle using the standard ISO 8855 coordinate system. The corners of the polygon are defined by the lateral and longitudinal locations where the plane of the outside edge of each tyre makes contact with the road. This plane is defined by running a perpendicular line from the outer most edge of the tyre to the ground at the wheelbase, as illustrated in Figure 1-2.

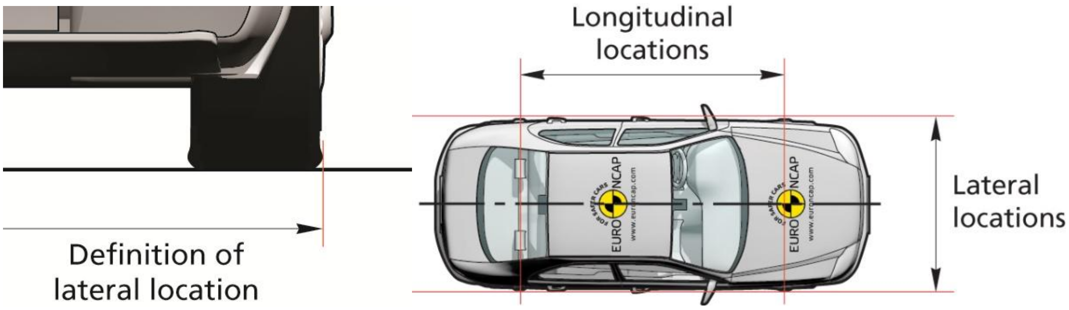


Figure 1-2: Vehicle dimensional measurements

The vehicle's wheelbase and the lateral and longitudinal locations shall be measured and recorded.

Requirements for Steering Robot friction levels should be checked prior to testing, as detailed in the Technical Bulletin TB 038.

2 TEST PROCEDURE

Testing of the Lane Support Systems is to be conducted, where applicable, with the DSM system recognising the driver as being in a distracted state.

For test paths that are not defined in Chapter 5, see *Appendix B – Lane Departure Paths* for more detail.

2.1 Single vehicle

2.1.1 Driver Acceptance

2.1.1.1 Driveability

a) Overriding Torque

Perform two closed-loop calibration runs on each of the nominated test points for Lane Departure – Road Edge, Solid Line, LKA Dashed, at 70 km/h.

Calibration runs are to be completed to determine the VUT's lane support system response timing and characteristics.

Run 1: Complete the required test path with all lane support systems turned OFF

Run 2: Complete the required test path with all system turned ON

The test laboratory shall record and monitor the VUT steering wheel torque throughout both tests and compare profiles for notable differences in the overriding torque requirements for either system setting.

b) Continuous Intervention

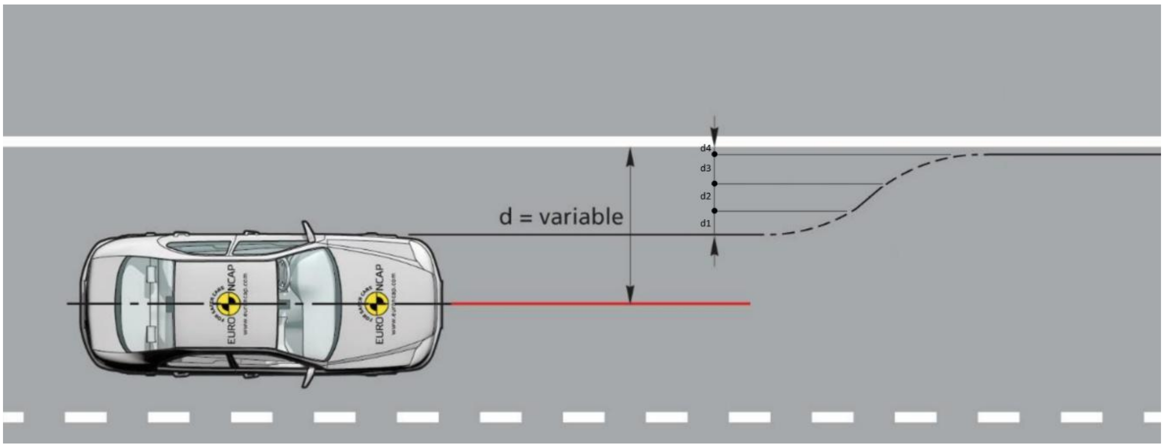
Continuous intervention testing will be conducted between 0.2m/s and 0.6m/s lateral speeds (per the table below) The test lab must conduct two test runs per lateral speed, and against both solid and dashed line markings on either side of the VUT.

Run 1: Complete the required test path with all lane support systems turned OFF

Run 2: Complete the required test path with all system turned ON

The VUT shall be driven at 70km/h and follow the test path (hold path mode), in which the test laboratory will monitor and record the steering wheel torque.

V_{lat}	R	d1	d2	d3	d4
0.2m/s	1200	0.06	0.59	0.06	0.05
0.3m/s		0.14	0.71	0.14	
0.4m/s		0.24	0.51	0.24	
0.5m/s		0.38	0.32	0.38	
0.6m/s		0.54	0.01	0.54	



The duration of intervention will be measured from [the first instance that the steering torque indicates an LSS response is active], until such time that the LSS response is fully suppressed, and the steering torque requirement closely and consistently matches the inactive system measurement. This applies to Lane Departure – Road Edge, Solid Line, LKA Dashed within any speed of Standard Range.

c) Steering Velocity

The test laboratory shall record and monitor the VUT steering velocity (or alternative metrics specified by the Vehicle Manufacturer) until test end for all Lane Departure – Road Edge.

d) Returning V_{lat}

The test laboratory shall record and monitor the VUT lateral velocity until test end for all Lane Departure – Road Edge.

2.1.1.2 Driver State Link

If a vehicle is equipped with a Driver Status Monitoring system that can adjust the LSS sensitivity with respect to the level of attentiveness of the driver; the manufacturer is encouraged to inform Euro NCAP on the specific details of this driver state link strategy.

In accordance with the information provided, and at Euro NCAP's direction, the test laboratory will verify the lane support system performance for both inattentive and attentive states.

2.1.2 Lane Departure

2.1.2.1 Road edge

The standard and extended test Ranges for Lane Departure – Road Edge are shown below:

ELK-RE	0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h						
60 km/h						
70 km/h						
80 km/h						
90 km/h						
100 km/h						

Standard Range

Extended Range

The following test track and lane marking format is applied to the standard and extended test ranges.

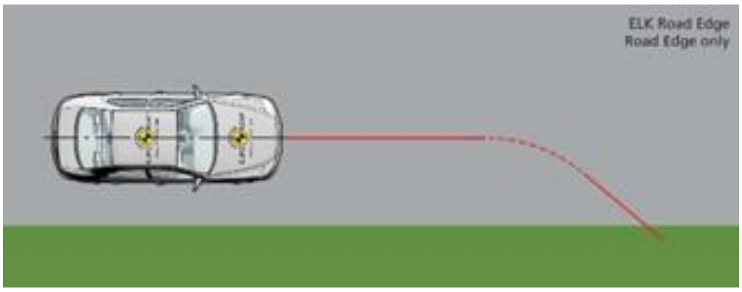


Figure 2-1 Lane Departure - Road Edge test format

The test lab shall record and monitor the timing of the Lane Departure Warning (haptic only) during tests conducted for the extended range of Lane Departure – Road Edge.

2.2 Car & PTW

2.2.1 ELK Car-to-Car Oncoming

For the oncoming scenario, the GVT will follow a straight-line path in the lane adjacent to the VUT's initial position, in the opposite direction to the VUT. The straight-line path of the target will be 1.5m from the inner side of the centre dashed lane marking of the VUT lane.

The paths of the VUT and target vehicle will be synchronised so that the reference point of the GVT meet with the VUT at a 90% impact location (assuming no system reaction).

The standard and extended test ranges for ELK Car-to-Car Oncoming are shown below:

ELK-ON	Target	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s
50 km/h	50 km/h				
60 km/h	60 km/h				
70 km/h	70 km/h				
80 km/h	80 km/h				
90 km/h	90 km/h				
100 km/h	100 km/h				

Standard Range
Extended Range

The following test track and lane marking format is applied to the standard and extended test ranges.

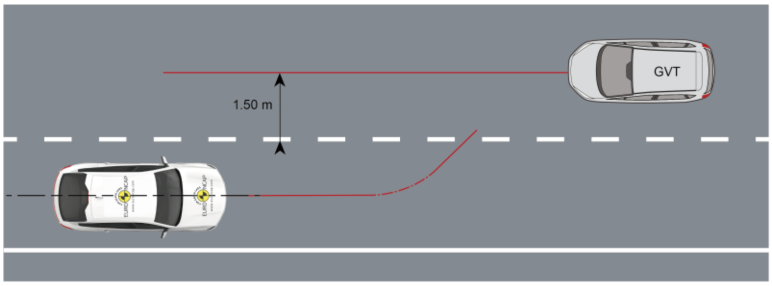


Figure 2-2 ELK Car-to-Car Oncoming test format

2.2.2 ELK Car-to-Car Overtaking

For the overtaking scenario a GVT will follow a straight-line path in the lane adjacent to the VUT's initial position at the driver side, in the same direction as the VUT. The straight-line path of the target will be 1.5m from the inner side of the centre dashed lane marking of the VUT lane.

The paths of the VUT and target vehicle will be synchronised so that the longitudinal position of the leading edge of the target vehicle is equal to that of the rear axle of the VUT at the impact point (assuming no system reaction).

ELK Car-To-Car Overtaking tests will be performed with 0.1m/s incremental steps within the lateral velocity range of 0.3 to 0.6m/s for unintentional lane change, and 0.5 to 0.7m/s for intentional lane changes for departures toward the driver side only. Intentional lane change manoeuvres will be conducted with the turn indicator ON.

The standard and extended test Ranges for ELK Car-to-Car Overtaking are shown below:

ELK-OV	Target	0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h	60 km/h						
60 km/h	70 km/h						
70 km/h	80 km/h						
80 km/h	90 km/h						
90 km/h	100 km/h						
100 km/h	110 km/h						
110 km/h	120 km/h						
120 km/h	130 km/h						
130 km/h	140 km/h						
140 km/h	150 km/h						

Standard Range

Extended Range

The following test track and lane marking format is applied to the standard and extended test ranges.

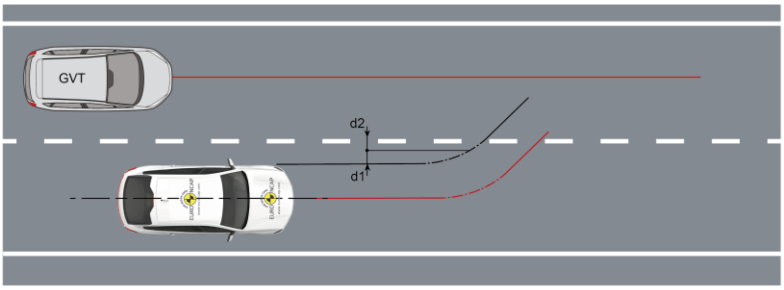


Figure 2-3 ELK Car-to-Car Overtaking test format

2.2.3 ELK Car-to-Motorcyclist Oncoming

For the oncoming scenario the EMT will follow a straight-line path at 70 km/h in the lane adjacent to the VUT's initial position, in the opposite direction to the VUT who also drives at 70 km/h. The straight-line path of the target will be 1m for the EMT from the inner side of the centre dashed lane marking of the VUT lane.

The standard and extended test ranges for ELK Car-to-Motorcyclist Oncoming are shown below:

ELK-ON	Target	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s
50 km/h	50 km/h				
60 km/h	60 km/h				
70 km/h	70 km/h				
80 km/h	80 km/h				
90 km/h	90 km/h				
100 km/h	100 km/h				

Standard Range
Extended Range

The following test track and lane marking format is applied to the standard and extended test ranges.

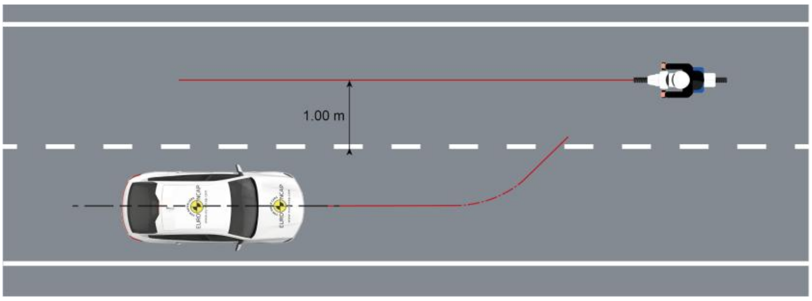


Figure 2-4 ELK Car-to-Motorcyclist Oncoming test format

5.2.3.3

The paths of the VUT and EMT will be synchronised so that the front wheel of the EMT impacts the VUT at a 110% impact location (assuming no system reaction).

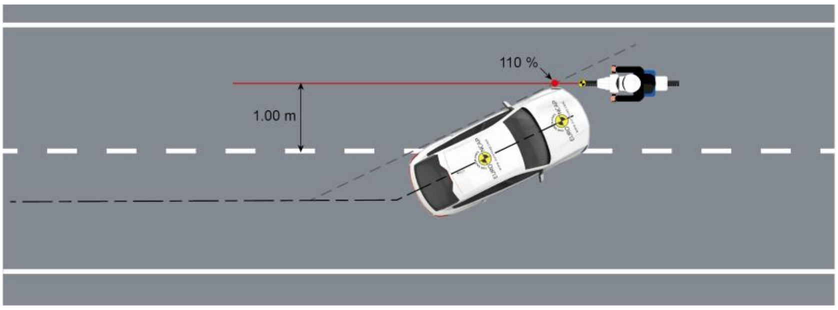


Figure 2-5 Standard Range impact location for ELK Car-to-Motorcyclist Oncoming

2.2.4 ELK Car-to-Motorcyclist Overtaking

For the overtaking scenario a EMT will follow a straight-line path in the lane adjacent to the VUT's initial position at the driver side, in the same direction as the VUT. The straight-line path of the target will be 1m for the EMT from the inner side of the centre dashed lane marking of the VUT line

ELK Car-To-Motorcyclist Overtaking tests will be performed with 0.1m/s incremental steps within the lateral velocity range of 0.3 to 0.6m/s for unintentional lane change, and 0.5 to 0.7m/s for intentional lane changes.

Lane departures for ELK Car-to-Motorcyclist Overtaking will be performed toward the driver side only, and intentional lane change manoeuvres will be conducted with the turn indicator ON.

The standard and extended test ranges for ELK Car-to-Motorcyclist Overtaking are shown below:

ELK-OV	Target	0.2 m/s	0.3 m/s	0.4 m/s	0.5 m/s	0.6 m/s	0.7 m/s
50 km/h	60 km/h						
60 km/h	70 km/h						
70 km/h	80 km/h						
80 km/h	90 km/h						
90 km/h	100 km/h						
100 km/h	110 km/h						
110 km/h	120 km/h						
120 km/h	130 km/h						
130 km/h	140 km/h						
140 km/h	150 km/h						

Standard Range
Extended Range

The following test track and lane marking format is applied to the standard and extended test ranges.

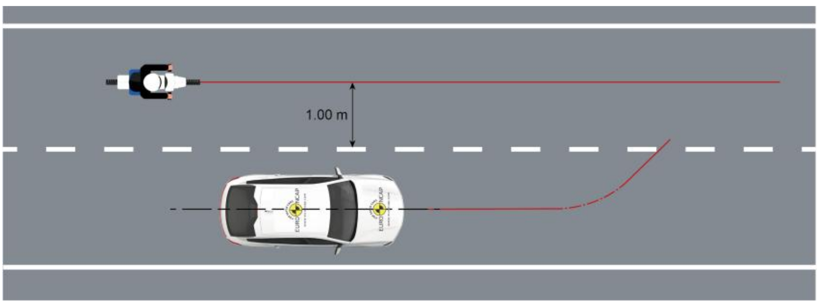


Figure 2-6 ELK Car-to-Motorcyclist Overtaking test format

The paths of the VUT and EMT will be synchronised so that the front wheel of the EMT coincides with the rear axle of the VUT at the impact point (assuming no system reaction).

2.2.5 Blind Spot Monitoring

Where the test vehicle is unable to meet the assessment criteria for the ELK Overtaking (Car and / or Motorcyclist) extended range scenarios, conduct assessment of the blind spot monitoring system, consisting on an on-road functionality verification that motorcyclists and cars in both adjacent lanes are detected at the applicable longitudinal speeds of the Extended Range.

3 TEST EXECUTION

3.1 VUT Pre-test Conditioning

3.1.1 General

A new car is used as delivered to the test laboratory; however, a car may have been used for other Euro NCAP active safety tests

If requested by the vehicle manufacturer and where not already performed for other tests, drive a maximum of 100km on a mixture of urban and rural roads with other traffic and roadside furniture to ‘calibrate’ the sensor system. Avoid harsh acceleration and braking.

3.1.2 Tyres

Condition the vehicle’s tyres in the following manner to remove the mould sheen, if this has not been done before for another test or in case the lab has not performed a 100km of driving:

- Drive around a circle of 30m in diameter at a speed sufficient to generate a lateral acceleration of approximately 0.5 to 0.6g for three clockwise laps followed by three anticlockwise laps.
- Immediately following the circular driving, drive four passes at 56km/h, performing ten cycles of a sinusoidal steering input in each pass at a frequency of 1Hz and amplitude sufficient to generate a peak lateral acceleration of approximately 0.5 to 0.6g.
- Make the steering wheel amplitude of the final cycle of the final pass double that of the previous inputs.

In case of instability in the sinusoidal driving, reduce the amplitude of the steering input to an appropriately safe level and continue the four passes.

3.1.3 System Check

Before any testing begins, perform a maximum of ten runs, to ensure proper functioning of the system.

3.2 Test Scenarios

Tests in all scenarios will be performed with 0.1 m/s incremental steps within the lateral velocities specified for the test scenarios.

For testing purposes, assume an initial straight-line path followed by a fixed radius as specified for the test scenarios, followed again by a straight line, hereby known as the test path. Control the VUT with driver inputs or using alternative control systems that can modulate the vehicle controls as necessary to perform the tests.

The vehicle manufacturer shall provide information describing the location when the closed loop path and/or speed control shall be ended so as not to interfere with the system intervention for each test The test laboratory shall then verify the release point for the highest lateral velocity. Otherwise, when the vehicle manufacturer does not provide information, two calibration runs shall be performed for each lateral velocity in order to determine when the system activates. Compare steering wheel torque, vehicle speed or yaw rate of both runs and determine where there is a notable difference that identifies the location of intervention.

- Run 1: Complete the required test path with the system turned OFF and measure the control parameter
- Run 2: Complete the required test path with the system turned ON and measure the control parameter

Complete the tests while ending the closed loop control before system activation as defined in 0. In the case of calibration runs, the release of steering control should occur on the test path and no less than 5m longitudinally before the location of intervention.

With the driver in the vehicle, weigh the front and rear axle loads of the vehicle.

If the intervention point of the function occurs before the target V_{latVUT} is reached, the test laboratory will conduct a verification check of the V_{latVUT}=0.6m/s test case (both for dashed and solid line) using a straight-line vehicle path intersecting with a curved lane marking which results in the yaw angle (Ψ_{VUT}) shown in 7.2.3. A maximum of 3 runs shall be conducted (both for solid and dashed line), where the system intervention and resulting DTLE is monitored.

When the closed loop path ends, the driver's hands or the control will remain passive on the steering wheel without applying deliberate force but reflecting the behaviour of an inattentive driver holding the steering wheel.

3.2.1 Test parameters

3.2.2 The following figure details the parameters used to create the test paths:

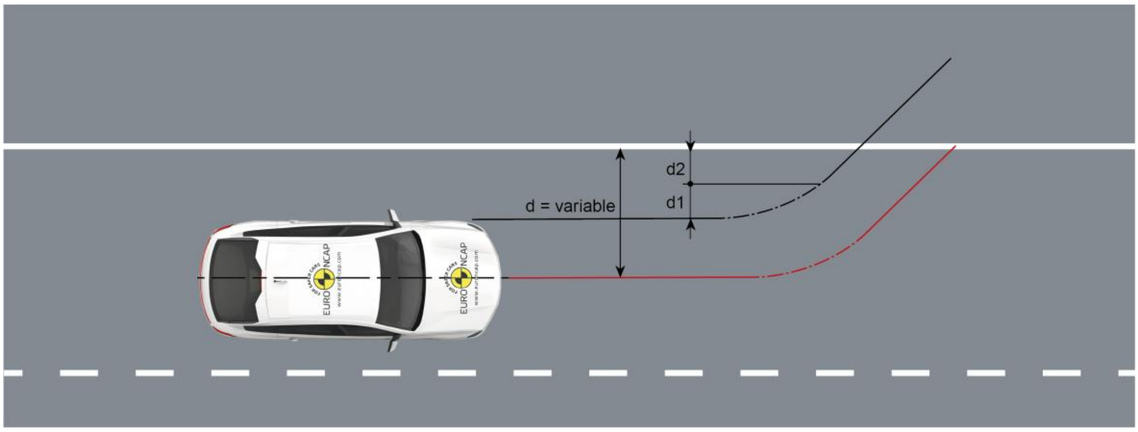


Figure 3-1: Vehicle paths definition

For the full definition of each scenario's test paths, see *Appendix B – Lane Departure Paths*.

4 ASSESSMENT CRITERIA & SCORING

4.1 General requirements

4.1.1 Driver Acceptance

The requirements specified for Driver Acceptance – Driveability are applicable for the whole operational speeds of the vehicle's lane support system. Euro NCAP will monitor the performance of these metrics throughout all testing performed within the Standard Range longitudinal speeds; and may also conduct spot checking to verify performance at speeds outside of the standard and extended Ranges defined for each scenario.

To be eligible for scoring points in Driver State Link, the system shall meet the requirements of Driveability.

4.1.2 Lane Departure

To be eligible for scoring points in Lane Departure, the ELK function of the LSS system needs to be default ON at the start of every journey and deactivation of the system should not be possible with a momentary single push on a button.

For any system, the driver must be able to override the intervention by the system.

4.2 Method of assessment

The Vehicle Manufacturer shall provide the Euro NCAP with data detailing the predicted performance of the LSS system for all test scenarios. The predicted performance will be used as a reference to identify discrepancies between the predicted results and the test results.

Each scenario in this assessment (except for Driver Acceptance) consists of a matrix combining vehicle & target longitudinal speeds, and ranges of vehicle lateral speeds. Each combination in a matrix is referred to as grid cell. The grid cells forming a test scenario matrix are grouped into two groups: 1) Standard range and 2) Extended range.

4.2.1 Standard Ranges

For score calculation in the standard ranges, each grid cell is given a maximum score of 1 point. Points are awarded as follows:

- Car & PTW
  - PASS (Avoidance) = 1 point
  - FAIL (Impact) = 0 points
- Single Vehicle
  - Vlat from 0.2 to 0.6m/s
    - ELK (PASS) = 1 point
    - ELK (FAIL) = 0 points

The total score of a scenario's standard test range is then normalized to the maximum available score for the standard test range of that scenario (rounded up to the nearest decimal point).

4.2.2 Extended Ranges

To be eligible for scoring points in the extended ranges across scenarios, ≥50% of the total available score is required to have been awarded for the standard test range.

For score calculation in the extended ranges, each grid cell which passes the acceptance criteria according to the vehicle manufacturer's prediction is given a score of 0.5 or 1 point. Points are awarded as follows:

- Car & PTW
  - PASS (Avoidance) = 1 point
  - BSM = 0.5 points
  - FAIL (Impact) = 0 points
- Single Vehicle
  - Vlat from 0.2 to 0.7m/s
    - ELK (PASS) = 1 point
    - LDW (PASS) = 0.5 points
    - LDW and ELK (FAIL) = 0 points

The score summed from the extended range is then normalized to the maximum available score for each standard range of each scenario (rounded to hundredth).

The total score for each extended range in any given scenario is calculated as follows:

Extended Range Scoring	
% of total available score	**Total score**
50 ≤ X < 75	50% of total available score
75 ≤ X < 100	75% of total available score
X = 100	100% of total available score

4.2.3 Robustness

To be eligible for scoring points in the Robustness Layers across scenarios, ≥50% of the total available score is required to have been awarded for the standard test range.

The score for each Robustness layer in any given scenario is calculated as follows:

Robustness Layers Scoring	
Performance *	**Total score**
YES	100% of total available score
NO	0% of total available score

*Against grid cells within Standard Range where there is performance

4.2.4 Verification tests

[The exact number of verification tests and overall acceptance criteria for the verification testing are still to be agreed withing the WG]

4.3 Assessment criteria

4.3.1 Single vehicle

4.3.1.1 Driver Acceptance

A maximum of 5 points are available for Driver Acceptance: 2 points for Driveability and 3 points for Driver State Link.

4.3.1.2 Driveability

The LSS system shall meet below conditions to be able to score points in Driveability:

1. Overriding torque – the torque applied by the steering robot to maintain the steering wheel angle must not exceed 3.0Nm + [0.5Nm] while the lane support system is active.
    - This KPI does not apply if the lane support system is suppressed via an overarching driver intention monitoring (DIM) strategy.
2. Continuous intervention – a vehicle's lane support system must not attempt to intervene over the driver intent for a duration longer than 3 seconds.
    - This KPI does not apply if the lane support system is suppressed via an overarching driver intention monitoring (DIM) strategy.
3. Steering velocity – for tests ≥70km/h, the lane support system must not provide a heading correction which results in a steering wheel velocity exceeding the limits defined in the table below.

Lateral Speed	0.2m/s	0.3m/s	0.4m/s	0.5m/s	0.6m/s
Steering Velocity	± 15 ^{O}/sec	± 20 ^{O}/sec	± 25 ^{O}/sec	± 30 ^{O}/sec	± 35 ^{O}/sec

At the test laboratory's discretion, the steering velocity limit is applied from when the steering robot enters open loop, or from when the VUT has met the test's target V_{lat}.

4. Returning V_{lat} – for each test monitored where Vlat >0.3, the lane support system shall redirect the VUT such that the correction results in a returning lateral velocity less than or equal to the test's targeted V_{lat}. Measurement of the returning V_{lat} will be taken two seconds after the maximum DTLE. For Vlat ≤0.3m/s, the returning Vlat shall be ≤0.3 m/s.

If a vehicle does not meet these criteria, or if a metric is not compatible with the VUT's lane support system (i.e. differential braking system, etc); the vehicle manufacturer can appeal to the secretariat with justification that the lane support system design avoids harsh or sudden interventions, and will be acceptable to drivers.

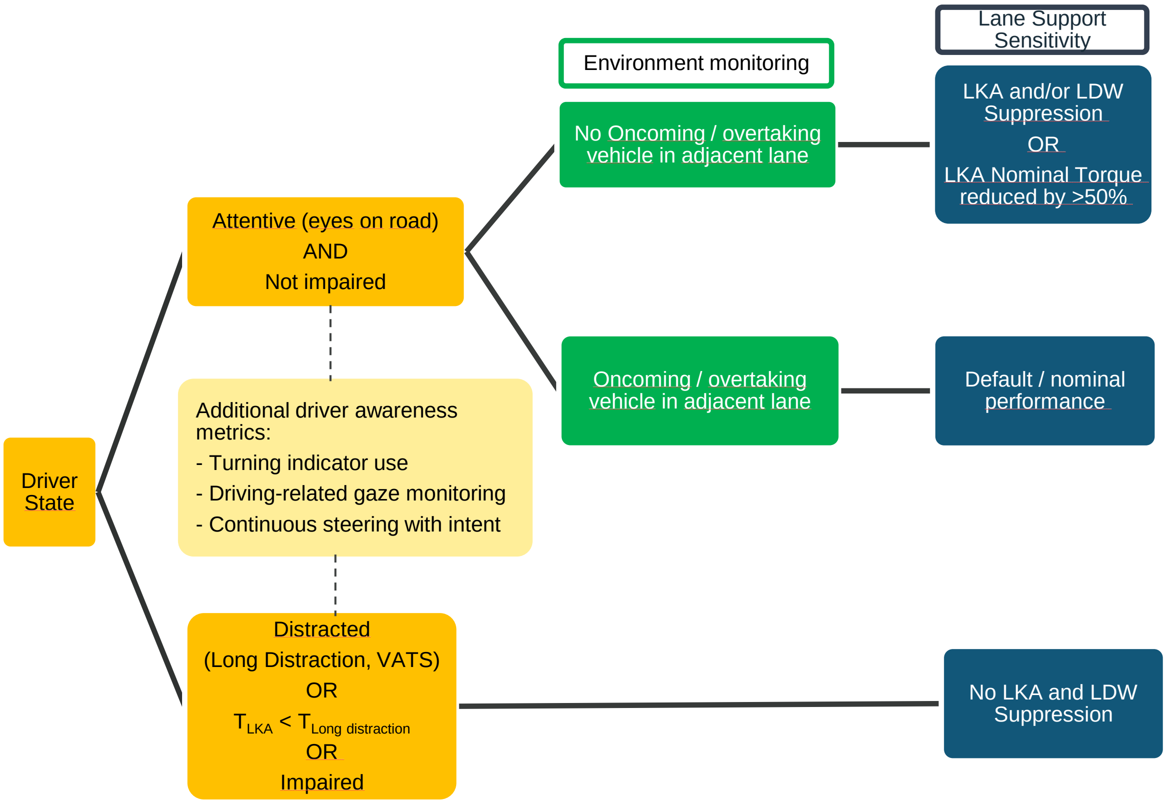
Based on this justification, the driveability assessment may be overruled by the Euro NCAP secretariat.

4.3.1.3 Driver State Link

To be able to score points in Driver State Link, the following conditions shall be met:

- The warning and intervention sensitivity of the LSS system shall change according to the state of the driver detected by the DSM, as described in the Euro NCAP Driver Engagement Protocol.
- The DSM shall offer minimum performance across different driver states as follows:
    - Long distraction, Short Distraction, Phone Use: ≥50% of total intervention score each
    - Impairment (Drowsiness)
    - Sleep (if no combined lateral and longitudinal control is available)
- The sensitivity change shall be immediately set back to nominal if DSM is degraded , non-functional or turned off.

LSS sensitivity changes shall ensure LKA and LDW availability when the driver is classified as distracted and/or impaired, AND partially or fully suppress intervention when the driver is classified as attentive (eyes on road) and non-impaired:



Where:
Awareness metrics: specific conditions indicating driver's awareness of the vehicle position in lane. It is permissible for the OEM to implement specific Lane Support Sensitivity changes according to the following conditions:

- Turning indicator use: e.g., overruling the LKA intervention for a driver previously assessed as impaired
- Gaze monitoring: specific Lane Support Sensitivity dependant on the driver's gaze direction, e.g.:
    - Gaze towards central, downward regions: Forward Support Sensitivity change for a vehicle drifting to either left or right side lane boundaries (e.g., in-vehicle infotainment system)
    - Gaze toward right regions: Lane Support Sensitivity change for a vehicle drifting to left-side lane boundaries (e.g., passenger side mirror)
    - Gaze toward left regions: Lane Support Sensitivity change for a vehicle drifting to right-side lane boundaries (e.g., driver's window)

For lateral support sensitivity, the intervention strategy shall be activated:

- At the latest when the driver state has been classified as transient.
- ≤ 1 second of any continuous gaze away from forward road view if the estimated time to LKA intervention is shorter than the long distraction time ($T_{LKA} < T_{Long\ distraction}$)

4.3.1.4 Lane Departure

4.3.1.5 Road edge

The limit value for DTLE in Lane Departure - Road Edge tests is set to -0.1m, meaning that the vehicle is only allowed to have a part of the front wheel outside of the road edge.

4.3.1.6 Lane Departure Warning

Where the test vehicle is unable to meet the assessment and performance criteria for the extended range of Lane Departure – Road Edge tests, the vehicle becomes eligible for the assessment of the Lane Departure Warning.

Any LDW system that issues a haptic warning clearly relating to the lateral control of the vehicle noticeable by the driver (e.g. notable heading correction, steering wheel vibration, etc.) before a DTLE of -0.1m is awarded when active at lateral velocities up to at least 0.7m/s.

4.3.2 Car & PTW

4.3.2.1 ELK Oncoming & Overtaking

For all ELK Car-to-Car & Car-to-Motorcyclist Oncoming and Overtaking tests with an oncoming or overtaking vehicle, the assessment criteria used is "no impact", meaning that the VUT is not allowed to contact* the overtaking or oncoming vehicle target at any time during the test.

** For motorcyclist, the lateral separation between the VUT and the Oncoming or Overtaking EMT must be >0.3m at any time during the test.*

4.3.2.2 Blind Spot Monitoring

Where the test vehicle is unable to meet the assessment and performance criteria for the extended range of ELK Overtaking (Car and Motorcyclist) tests, the test vehicle becomes eligible for the assessment of the blind spot monitoring system.

For the blind spot monitoring tests, the assessment criteria used is the visual blind spot information that shall be supplied in respect to vehicles in the blind spot of the VUT

4.3.3 Robustness

In order to evaluate the overall robustness of the system, the Standard Range of each scenario (where there is performance) is assessed against individual parameter or condition variations referred to as layers, clustered in 3 types: VUT, Target and Environment.

<table>
<tr><th colspan="2">Robustness layers</th><th rowspan="2">Description</th><th rowspan="2">Verification Test</th><th rowspan="2">Input source</th></tr>
<tr><th>Type</th><th>Layer</th></tr>
<tr><td>VUT</td><td>Impact location</td><td>System performance under different projected impact location</td><td>Yes</td><td>VTA or OEM self-claim</td></tr>
<tr><td rowspan="3">Target (ELK Oncoming and Overtaking)</td><td>Initial position offset</td><td>System performance under a small variance in the nominal target initial position</td><td>Yes</td><td>VTA or OEM self-claim</td></tr>
<tr><td>Type</td><td>System ability to detect different collision partner types with similar kinematics</td><td>No</td><td rowspan="6">FOT data**</td></tr>
<tr><td>Appearance</td><td>System ability to detect same collision partner type but with different appearance (e.g., colour, shape)</td><td>No</td></tr>
<tr><td>Target (Road Edge)</td><td>Appearance</td><td>System performance against diverse lane boundaries, e.g., road edge, lane lines of different colour/width/type</td><td>No*</td></tr>
<tr><td rowspan="3">Environment</td><td>Adverse weather conditions</td><td>Functionality available under the presence of Rain, Fog, Dirt/ice/moisture</td><td>No</td></tr>
<tr><td>Illumination (Night time)</td><td>System ability to operate in darkness (1 lux)</td><td>No*</td></tr>
<tr><td>Illumination - Glare</td><td>Functionality available under the presence of glare caused by Low sun (all scenarios)</td><td>No</td></tr>
</table>

*May be tested under request of Euro NCAP Secretariat.

** Where FOT data is required, the Vehicle Manufacturer shall demonstrate that the system perception is not significantly degraded, assessed in real driving conditions. This is to be reported according to the provisions set forth in the FOT Data Template Technical Bulletin.

4.3.3.1 Verification Tests

Where verification tests are done, the following conditions apply:

<table>
<tr><th colspan="2">Robustness</th><th rowspan="2">Scenarios</th><th rowspan="2">Test condition*</th><th rowspan="2">Assessment Criteria</th></tr>
<tr><th>Type</th><th>Layer</th></tr>
<tr><td>VUT</td><td>Impact location**</td><td rowspan="2">Car & PTW</td><td>Range change:
- Oncoming: ±10%
- Overtaking: +50%</td><td>Same</td></tr>
<tr><td rowspan="2">Target</td><td>Initial position Offset**</td><td>Range change:
- Path offset: ±0.25m</td><td>Same</td></tr>
<tr><td>Appearance</td><td rowspan="2">Single vehicle</td><td>Lane marking type, colour, width (verification during on-road test)</td><td>Same</td></tr>
<tr><td>Environ ment</td><td>Illumination (Night time)</td><td>Performance in darkness (1 lux) Applicable for Road Edge only – with high beams</td><td>Same</td></tr>
</table>

** Versus the condition used in the Standard Range.*

*** Parameter combinations shall ensure a TTC ≤ 3s (see 4.4)*

4.4 Scoring

4.4.1 Single vehicle

The point distribution for Single vehicle scenarios is summarized in the table below:

Single vehicle	Maximum Points			
	Standard Range 9	Extended Range 0.5	Robustness Layers 0.5	TOTAL 10
Driver Acceptance	**5**	-	-	**5**
Driveability	2	-	-	2
Driver State Link	3	-	-	3
Lane Departure	**4**	**0.5**	**0.5**	**5**
ELK Road edge*	4	0.5	0.5	5

* Half points awarded with LDW in Extended Range cases

4.4.2 Car & PTW

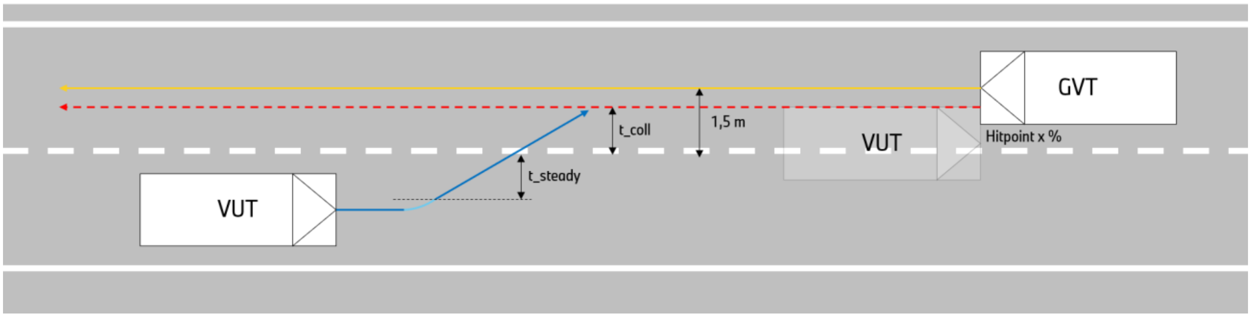
The point distribution for Car & PTW scenarios is summarized in the table below:

Car & PTW	Maximum Points			
	Standard Range 8	Extended Range 1	Robustness Layers 1	TOTAL 10
ELK Car-to-car	**4**	**0.5**	**0.5**	**5**
Oncoming	2	0.25	0.25	2.5
Overtaking*	2	0.25	0.25	2.5
ELK Car-to-motorcyclist	**4**	**0.5**	**0.5**	**5**
Oncoming	2	0.25	0.25	2.5
Overtaking*	2	0.25	0.25	2.5

* Half points awarded with BSM in Extended Range cases

APPENDIX A ONCOMING & OVERTAKING TEST CASES

A.1 C2C Oncoming

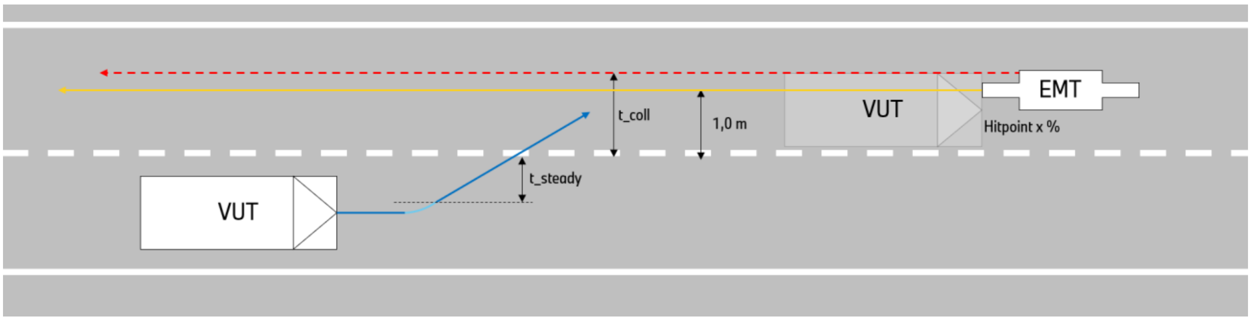


Standard Range											
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h]					
						100	120	140	160	180	200
90	0,2	0,70	3,50	0,824	**4,12**	114	137	160	183	206	229
90	0,3	0,90	3,00	0,824	2,75	76	92	107	122	137	153
90	0,4	0,80	2,00	0,824	2,06	57	69	80	92	103	114
90	0,5	0,75	1,50	0,824	1,65	46	55	64	73	82	92
90	0,6	0,60	1,00	0,824	1,37	38	46	53	61	69	76

Robustness Layer (Impact location)											
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h]					
						-	-	144	-	-	-
100	0,2	0,70	3,50	0,644	**3,22**	-	-	129	-	-	-
100	0,3	0,90	3,00	0,644	2,15	-	-	86	-	-	-
100	0,4	0,80	2,00	0,644	1,61	-	-	64	-	-	-
100	0,5	0,75	1,50	0,644	1,29	-	-	52	-	-	-
100	0,6	0,60	1,00	0,644	1,07	-	-	43	-	-	-
90	0,2	0,70	3,50	0,824	**4,12**	-	-	165	-	-	-
90	0,3	0,90	3,00	0,824	2,75	-	-	110	-	-	-
90	0,4	0,80	2,00	0,824	2,06	-	-	82	-	-	-
90	0,5	0,75	1,50	0,824	1,65	-	-	66	-	-	-
90	0,6	0,60	1,00	0,824	1,37	-	-	55	-	-	-
80	0,2	0,70	3,50	1,004	**5,02**	-	-	201	-	-	-
80	0,3	0,90	3,00	1,004	**3,35**	-	-	134	-	-	-
80	0,4	0,80	2,00	1,004	2,51	-	-	100	-	-	-
80	0,5	0,75	1,50	1,004	2,01	-	-	80	-	-	-
80	0,6	0,60	1,00	1,004	1,67	-	-	67	-	-	-

Robustness Layer (Initial position)												
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m]						
						vdiff_long [km/h]						
						-	-	144	-	-	-
90	0,2	0,70	3,50	1,074	**5,37**	-	-	215	-	-	-
90	0,3	0,90	3,00	1,074	**3,58**	-	-	143	-	-	-
90	0,4	0,80	2,00	1,074	2,69	-	-	107	-	-	-
90	0,5	0,75	1,50	1,074	2,15	-	-	86	-	-	-
90	0,6	0,60	1,00	1,074	1,79	-	-	72	-	-	-
90	0,2	0,70	3,50	0,574	2,87	-	-	115	-	-	-
90	0,3	0,90	3,00	0,574	1,91	-	-	77	-	-	-
90	0,4	0,80	2,00	0,574	1,44	-	-	57	-	-	-
90	0,5	0,75	1,50	0,574	1,15	-	-	46	-	-	-
90	0,6	0,60	1,00	0,574	0,96	-	-	38	-	-	-

A.2 C2M Oncoming



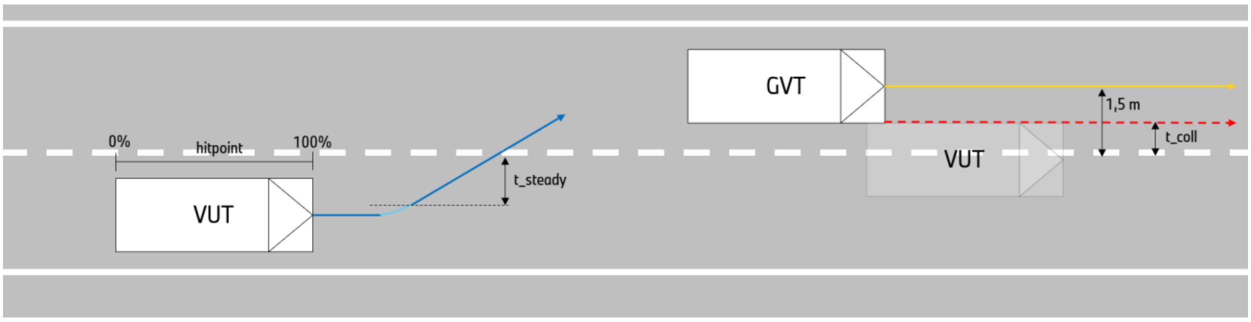
Standard Range											
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h]					
						100	120	140	160	180	200
110	0,2	0,70	3,50	0,820	4,10	114	137	159	182	205	228
110	0,3	0,90	3,00	0,820	2,73	76	91	106	121	137	152
110	0,4	0,80	2,00	0,820	2,05	57	68	80	91	103	114
110	0,5	0,75	1,50	0,820	1,64	46	55	64	73	82	91
110	0,6	0,60	1,00	0,820	1,37	38	46	53	61	68	76

Robustness Layer (Impact location)											
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h]					
						-	-	144	-	-	-
120	0,2	0,70	3,50	0,640	3,20	-	-	128	-	-	-
120	0,3	0,90	3,00	0,640	2,13	-	-	85	-	-	-
120	0,4	0,80	2,00	0,640	1,60	-	-	64	-	-	-
120	0,5	0,75	1,50	0,640	1,28	-	-	51	-	-	-
120	0,6	0,60	1,00	0,640	1,07	-	-	43	-	-	-
110	0,2	0,70	3,50	0,820	4,10	-	-	164	-	-	-
110	0,3	0,90	3,00	0,820	2,73	-	-	109	-	-	-
110	0,4	0,80	2,00	0,820	2,05	-	-	82	-	-	-
110	0,5	0,75	1,50	0,820	1,64	-	-	66	-	-	-
110	0,6	0,60	1,00	0,820	1,37	-	-	55	-	-	-
100	0,2	0,70	3,50	1,000	5,00	-	-	200	-	-	-
100	0,3	0,90	3,00	1,000	3,33	-	-	133	-	-	-
100	0,4	0,80	2,00	1,000	2,50	-	-	100	-	-	-
100	0,5	0,75	1,50	1,000	2,00	-	-	80	-	-	-
100	0,6	0,60	1,00	1,000	1,67	-	-	67	-	-	-

Robustness Layer (Initial position)											
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h]					
						-	-	144	-	-	-

110	0,2	0,70	3,50	1,070	5,35	-	-	214	-	-	-
110	0,3	0,90	3,00	1,070	3,57	-	-	143	-	-	-
110	0,4	0,80	2,00	1,070	2,68	-	-	107	-	-	-
110	0,5	0,75	1,50	1,070	2,14	-	-	86	-	-	-
110	0,6	0,60	1,00	1,070	1,78	-	-	71	-	-	-
110	0,2	0,70	3,50	0,820	4,10	-	-	164	-	-	-
110	0,3	0,90	3,00	0,820	2,73	-	-	109	-	-	-
110	0,4	0,80	2,00	0,820	2,05	-	-	82	-	-	-
110	0,5	0,75	1,50	0,820	1,64	-	-	66	-	-	-
110	0,6	0,60	1,00	0,820	1,37	-	-	55	-	-	-

A.3 C2C Overtaking



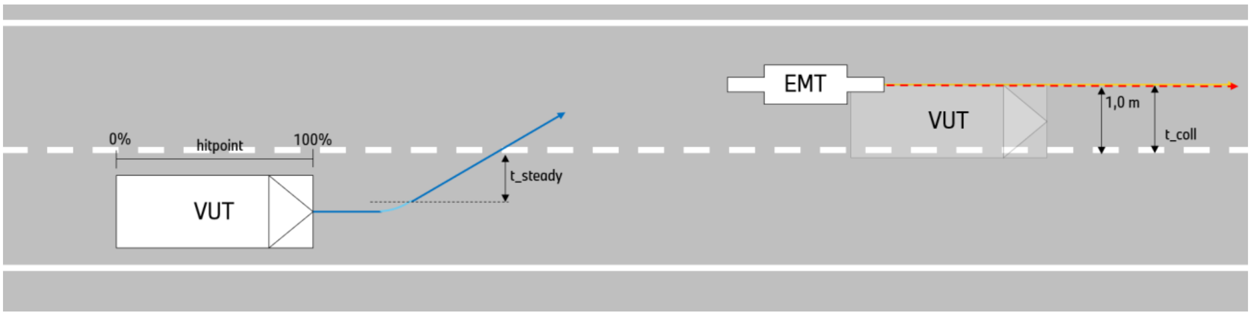
Standard Range							
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h] 10	TTC: front target, rear ego (this is necessary to incorporate the Impact Location lengthwise)
25	0,2	0,70	3,50	0,644	3,22	7,71	2,78
25	0,3	0,90	3,00	0,644	2,15	4,73	1,70
25	0,4	0,80	2,00	0,644	1,61	3,24	1,17
25	0,5	0,75	1,50	0,644	1,29	2,35	0,85
25	0,6	0,60	1,00	0,644	1,07	1,75	0,63
25	0,7	0,53	0,76	0,644	0,92	1,33	0,48

Robustness Layer (Impact location)							
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h] 8	TTC: front target, rear ego (this is necessary to incorporate the Impact Location lengthwise)
0	0,2	0,70	3,50	0,644	3,22	7,16	**3,22**
0	0,3	0,90	3,00	0,644	2,15	4,77	2,15
0	0,4	0,80	2,00	0,644	1,61	3,58	1,61
0	0,5	0,75	1,50	0,644	1,29	2,86	1,29
0	0,6	0,60	1,00	0,644	1,07	2,39	1,07
0	0,7	0,53	0,76	0,644	0,92	2,04	0,92
25	0,2	0,70	3,50	0,644	3,22	5,93	2,67
25	0,3	0,90	3,00	0,644	2,15	3,54	1,59
25	0,4	0,80	2,00	0,644	1,61	2,35	1,06
25	0,5	0,75	1,50	0,644	1,29	1,63	0,73
25	0,6	0,60	1,00	0,644	1,07	1,15	0,52
25	0,7	0,53	0,76	0,644	0,92	0,81	0,37
26	0,2	0,70	3,50	0,644	3,22	5,88	2,64
26	0,3	0,90	3,00	0,644	2,15	3,49	1,57
26	0,4	0,80	2,00	0,644	1,61	2,30	1,03
26	0,5	0,75	1,50	0,644	1,29	1,58	0,71
26	0,6	0,60	1,00	0,644	1,07	1,11	0,50
26	0,7	0,53	0,76	0,644	0,92	0,76	0,34
50	0,2	0,70	3,50	0,644	3,22	4,69	2,11
50	0,3	0,90	3,00	0,644	2,15	2,31	1,04
50	0,4	0,80	2,00	0,644	1,61	1,12	0,50
50	0,5	0,75	1,50	0,644	1,29	0,40	0,18
50	0,6	0,60	1,00	0,644	1,07	-0,08	-0,03
50	0,7	0,53	0,76	0,644	0,92	-0,42	-0,19

Robustness Layer (Initial position)							
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h] 8	TTC: front target, rear ego (this is necessary to incorporate the Impact Location lengthwise)
25	0,2	0,70	3,50	0,894	4,47	8,70	**3,92**
25	0,3	0,90	3,00	0,894	2,98	5,39	2,43
25	0,4	0,80	2,00	0,894	2,24	3,74	1,68
25	0,5	0,75	1,50	0,894	1,79	2,74	1,23
25	0,6	0,60	1,00	0,894	1,49	2,08	0,94
25	0,7	0,53	0,76	0,894	1,28	1,61	0,72
25	0,2	0,70	3,50	0,394	1,97	3,15	1,42

25	0,3	0,90	3,00	0,394	1,31	1,69	0,76
25	0,4	0,80	2,00	0,394	0,99	0,96	0,43
25	0,5	0,75	1,50	0,394	0,79	0,52	0,23
25	0,6	0,60	1,00	0,394	0,66	0,23	0,10
25	0,7	0,53	0,76	0,394	0,56	0,02	0,01

A.4 C2M Overtaking



Standard Range							
Impact Location [%]	vLat [m/s]	d2 [m]	t_steady [s]	d_coll [m]	t_coll [s]	Distance to target @ crossing [m] vdiff_long [km/h] 10	TTC: front target, rear ego (this is necessary to incorporate the Impact Location lengthwise)
25	0,2	0,70	3,50	1,000	5,00	12,66	**4,56**
25	0,3	0,90	3,00	1,000	3,33	8,03	2,89
25	0,4	0,80	2,00	1,000	2,50	5,71	2,06
25	0,5	0,75	1,50	1,000	2,00	4,33	1,56
25	0,6	0,60	1,00	1,000	1,67	3,40	1,22
25	0,7	0,53	0,76	1,000	1,43	2,74	0,99

APPENDIX B LANE DEPARTURE PATHS

			D1 depending on lateral and longitudinal speed								
Vehicle Speed	Lateral acceleration R=600 for V<70 km/h R=1200 for 70<=V< 100 R=2400 for V>=100 for Vlat <=0.4m/s	Lateral acceleration R=400 for V<70 km/h R=800 for 70<=V< 100 R=1600 for V>=100 for Vlat >0.4m/s	D1 (0.2)	D1 (0.3)	D1 (0.4)	D1 (0.5)	D1 (0.6)	D1 (0.7)	D1 (0.8)	D1 (0.9)	D1 (1.0)
50	**0.322**	**0.482**	**0.062**	**0.140**	**0.249**	**0.259**	**0.373**	**0.508**	**0.664**	**0.841**	**1.038**
60	**0.463**	**0.694**	**0.043**	**0.097**	**0.173**	**0.180**	**0.259**	**0.353**	**0.461**	**0.584**	**0.721**
70	**0.315**	**0.473**	**0.063**	**0.143**	**0.254**	**0.265**	**0.381**	**0.519**	**0.677**	**0.857**	**1.059**
72	**0.333**	**0.500**	**0.060**	**0.135**	**0.240**	**0.250**	**0.360**	**0.490**	**0.640**	**0.810**	**1.001**
80	**0.412**	**0.617**	**0.049**	**0.109**	**0.194**	**0.203**	**0.292**	**0.397**	**0.519**	**0.656**	**0.810**
90	**0.521**	**0.781**	**0.038**	**0.086**	**0.154**	**0.160**	**0.230**	**0.314**	**0.410**	**0.519**	**0.640**
100	**0.322**	**0.482**	**0.062**	**0.140**	**0.249**	**0.259**	**0.373**	**0.508**	**0.664**	**0.840**	**1.037**
110	**0.389**	**0.584**	**0.051**	**0.116**	**0.206**	**0.214**	**0.308**	**0.420**	**0.548**	**0.694**	**0.857**
120	**0.463**	**0.694**	**0.043**	**0.097**	**0.173**	**0.180**	**0.259**	**0.353**	**0.461**	**0.583**	**0.720**
130	**0.543**	**0.815**	**0.037**	**0.083**	**0.147**	**0.153**	**0.221**	**0.301**	**0.393**	**0.497**	**0.614**