

Safe Driving

Vehicle Assistance

Longitudinal Assistance

Test Protocol

Implementation November 2024

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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 Euro NCAP secretariat should be immediately informed. Any such incident may be reported 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:

Heavy Goods Vehicle (HGV) – a category N2 or N3 vehicle with gross mass exceeding 3,500kg.

Peak Braking Coefficient (PBC) – the measure of tyre to road surface friction based on the maximum deceleration of a rolling tyre, measured using the American Society for Testing and Materials (ASTM) F 2493-20 (SRTT16) standard reference test tyre, in accordance with ASTM Method E 1337-19 (2019), at a speed of 64.4 km/h, without water delivery. Alternatively, the method as specified in UNECE R13-H.

Adaptive Cruise Control (ACC) – a system engaged by the driver which monitors the road and traffic environment and automatically adjusts speed to maintain a safe following distance.

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

ACC braking performance – the outcome of the automatically applied braking when ACC is operational along with AEB, in terms of whether the collision was avoided or the resultant (relative) impact speed.

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

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

Vehicle Under Test (VUT) – the vehicle, or vehicle and trailer combination tested according to this protocol with a pre-crash collision mitigation or avoidance system on board.

Vehicle width – the widest point of the vehicle excluding the body, determined in accordance with EU Regulation 2021/535 Section F: List of devices and equipment that are not required to be taken into account for the determination of the outermost dimensions.

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

Time To Collision (TTC) – 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.

T_{Acc} – the time when the ACC system initiates speed reduction in response to the target ahead. Activation time is determined by identifying the last data point where the filtered acceleration signal is below -1.0 m/s^2 , and then going back to the point in time where the acceleration first crossed -0.3 m/s^2 .

T_{impact} – the time at which the profile around the front of the VUT coincides with the square box around the GVT.

V_{impact} – the speed of the VUT at T_{impact}.

V_{rel_impact} – the relative speed between the VUT and GVT at T_{impact} calculated by subtracting the speed of the GVT at T_{impact} from V_{impact}.

1 INTRODUCTION

An analysis of European road traffic crash data (where at least one HGV was involved) revealed that Heavy Goods Vehicle (HGV) front-to-rear collisions account for 9 % of passenger car and Light Commercial Vehicle (LCV or van) occupant fatalities and 17 % of HGV occupant fatalities. Considering all injury severities, those figures increase to 20 % and 49 % respectively.

Typical incidents include the HGV colliding with the rear of slow moving or stationary traffic on highways at high relative speeds because of a range of factors including driver distraction, fatigue or misjudgement. Where the HGV collides with a light vehicle the large difference in weight means that the light vehicle sees almost all of the change in velocity putting the occupant(s) of that vehicle at very high risk. Where the collision partner is a heavy vehicle, the large collision energy presents a risk of serious injury to the HGV driver and the occupants of the struck vehicle(s).

Adaptive Cruise Control (ACC) is an increasingly available HGV feature which, similar to AEB, monitors the road and traffic environment. When engaged by the driver, it controls speed to maintain a safe following gap and can support avoiding collisions, albeit with more modest deceleration at comfort braking levels. Feedback from industry suggests this feature is commonly used by drivers and could potentially bring some safety benefits in certain circumstances by reacting to hazards ahead slightly earlier than might be the case for AEB.

This protocol specifies the longitudinal assistance test procedures, which are used to evaluate system performance in a repeatable and reproducible manner for the HGV safety rating scheme.

2 REFERENCE SYSTEM

2.1 Convention

For both the VUT and the GVT use the convention specified in ISO 8855:1991 in which the x-axis points towards the front of the vehicle, the y-axis towards the left and the z-axis upwards (right hand system), with the origin at the most forward point on the centreline of the VUT for dynamic data measurements as shown in Figure 2-1.

Viewed from the origin, roll, pitch and yaw rotate clockwise around the x, y and z axes respectively. Longitudinal refers to the component of the measurement along the x-axis, lateral the component along the y-axis and vertical the component along the z-axis.

This reference system should be used for both left hand drive (LHD) and right hand drive (RHD) vehicles tested. Figure 2-1 shows the near and far side of the vehicle for a left hand drive (LHD) vehicle. The far side always corresponds to the hand of drive, and therefore swaps sides accordingly for a right hand drive (RHD) vehicle.

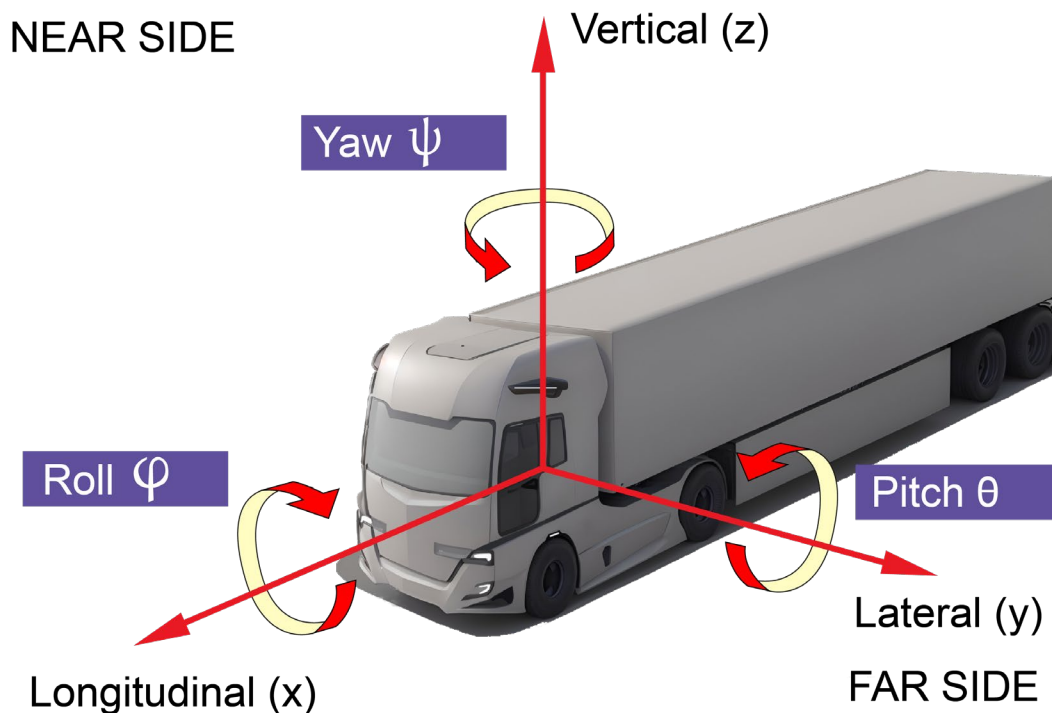


Figure 2-1 Coordinate system and notation (LHD & RHD) and near side – far side for LHD vehicle

2.2 Lateral Path Error

The lateral path error (Y_{VUT} error) is determined as the lateral distance between the centre of the front axle of the VUT when measured in parallel to the intended path, as shown in Figure 2-2.

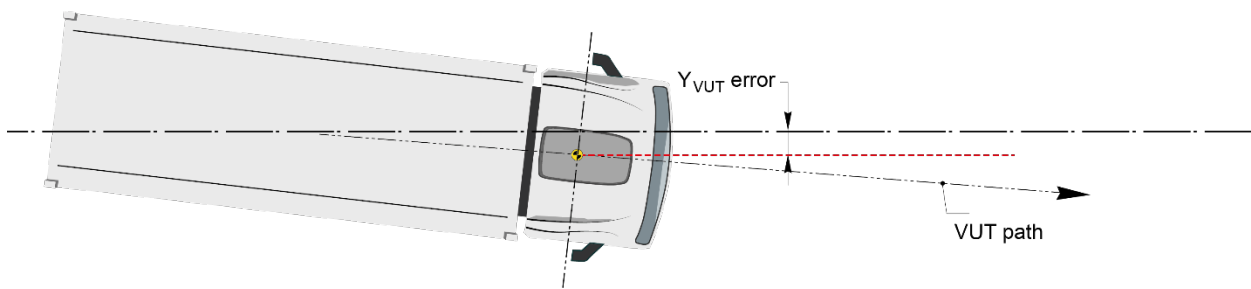


Figure 2-2 Lateral path error

2.3 Impact Location

The impact location is where the rear central reference point of the GVT coincides with the percentage of the width of the VUT, as shown in Figure 2-3.

For 0 % overlap, the centreline of the GVT is aligned with the near side of the VUT.

For 50 % overlap, the centreline of the GVT is aligned with the centreline of the VUT.

For 100 % overlap, the centreline of the GVT is aligned with the far side of the VUT.

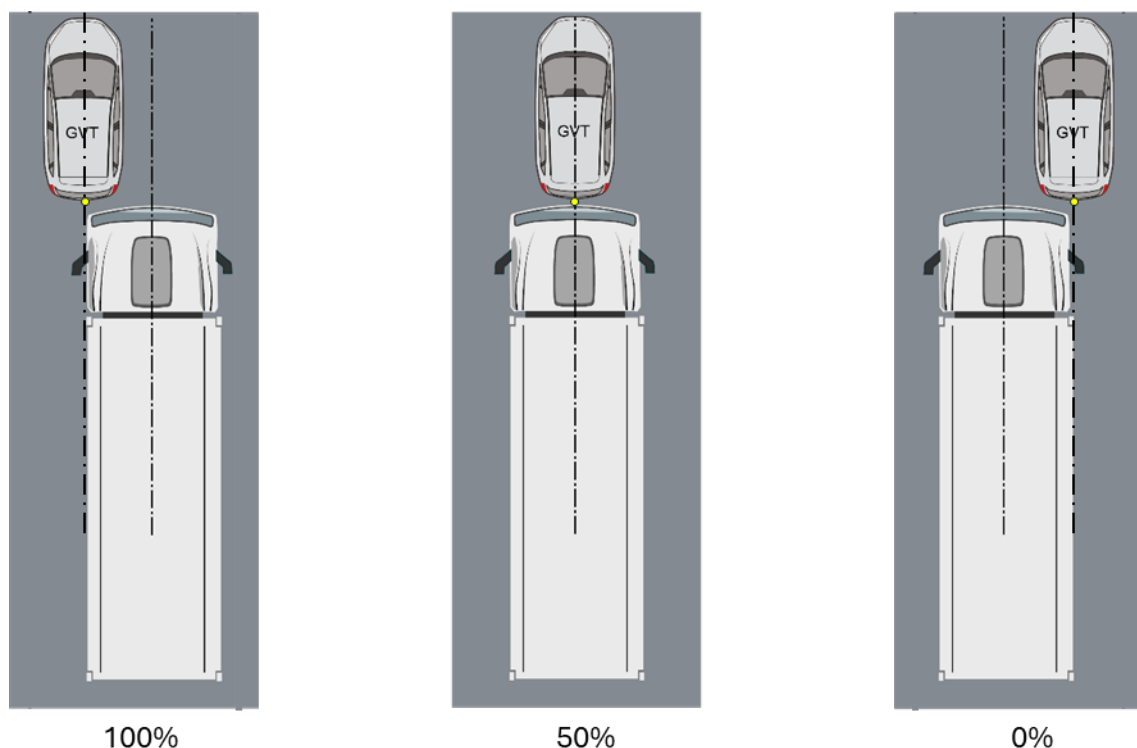


Figure 2-3 Impact location

2.4 Profile for Impact Speed Determination

A virtual profile is defined around the front of the VUT for V_{impact} calculation in case of a collision, determined in accordance with EU Regulation 2021/535 Section F: List of devices and equipment Euro NCAP

that are not required to be taken into account for the determination of the outermost dimensions. This profile is defined by six straight line segments connecting seven lateral locations that are equally distributed over the vehicle width minus 150 mm on each side, as shown in Figure 2-4. The foremost point at each lateral location may not necessarily be at the same height. The vehicle manufacturer is requested to provide profile xy coordinates for verification by the test laboratory.

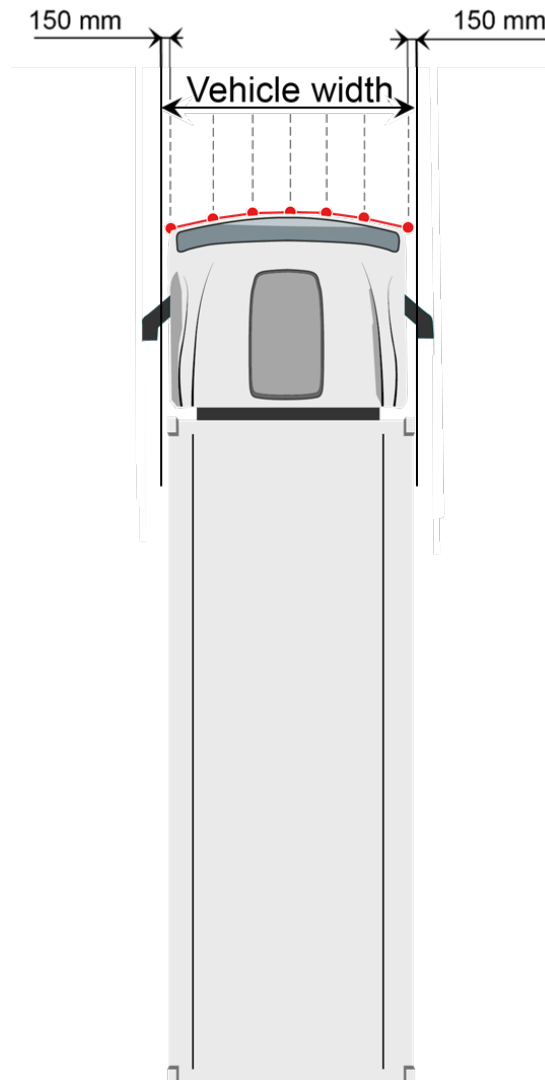


Figure 2-4 Virtual profiled line around the VUT front end

Around the GVT a virtual box is defined which is used to determine the impact speed. The dimensions of this virtual box are shown in Figure 2-5. For longitudinal scenarios, the reference point of the GVT is the rearmost centre point.

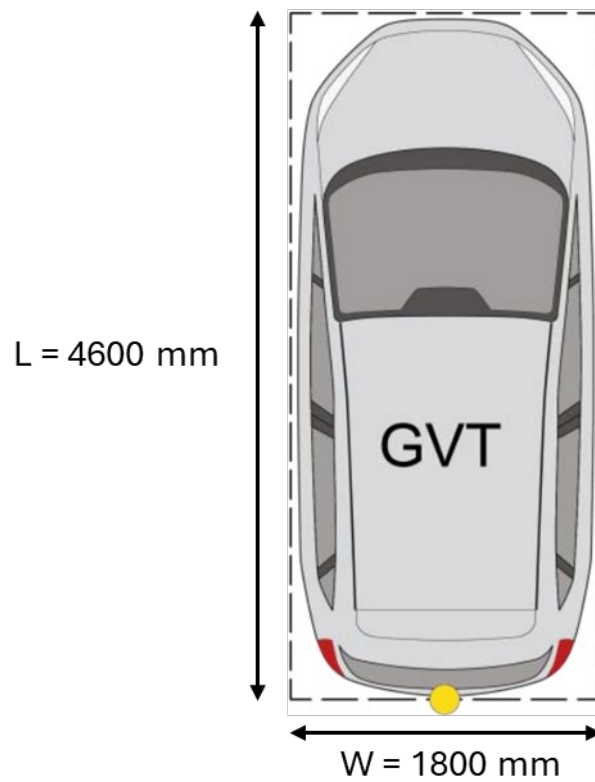


Figure 2-5 Virtual box dimensions around GVT

3 MEASURING EQUIPMENT

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

3.1 Measurements and Variables

Time	T
ACC HCRs: T_0 equals TTC = 4s	T_0
ACC HCRb: T_0 when GVT starts decelerating	
T_{ACC} , time when ACC initiates speed reduction	T_{AEB}
T_{impact} , time when VUT impacts GVT	T_{impact}
Position of the VUT during the entire test	X_{VUT}, Y_{VUT}
Position of the GVT during the entire test	X_{GVT}, Y_{GVT}
Speed of the VUT during the entire test	V_{VUT}
V_{impact} , VUT speed at T_{impact}	V_{impact}
V_{rel_impact} , V_{impact} minus GVT speed at T_{impact}	V_{rel_impact}
Speed of the GVT during the entire test	V_{GVT}
Acceleration of the VUT during the entire test	A_{VUT}
Acceleration of the GVT during the entire test	A_{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	Ω_{VUT}

3.2 Measuring Equipment

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

- VUT and GVT longitudinal speed to 0.1 km/h
- VUT and GVT lateral and longitudinal position to 0.03 m
- VUT heading angle to 0.1 °
- VUT and GVT yaw rate to 0.1 °/s
- VUT longitudinal acceleration to 0.1 m/s²
- VUT steering wheel velocity to 1.0 °/s

3.3 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 velocity and force are filtered with a 12 pole phaseless Butterworth filter with a cut off frequency of 10 Hz

4 TARGET SYSTEMS

4.1 Global Vehicle Target

Conduct tests in this protocol using the Global Vehicle Target (GVT) as shown in Figure 4-1 below. The GVT replicates the visual, radar and LIDAR attributes of a typical M1 passenger vehicle.



Figure 4-1 Global Vehicle Target (GVT)

To ensure repeatable results the combination of the propulsion system and GVT must meet the requirements as detailed in ISO 19206-3.

Only equipment listed in the current version of TB 029 – Suppliers List may be used for testing. The current version can be found on the Euro NCAP website.

The GVT is designed to work with the following types of sensors:

- Radar (24 and 77 GHz)
- Lidar
- Camera

When a manufacturer believes that the GVT is not suitable for another type of sensor system used by the VUT but not listed above, the manufacturer is asked to contact the Euro NCAP secretariat.

5 SYSTEM PERFORMANCE DATA

The vehicle manufacturer is requested to provide the Euro NCAP secretariat with colour data (expected impact speeds are not required) detailing the ACC performance of the VUT in the HCRs and HCRb scenarios for all impact location and test speed combinations. All data should be supplied by the manufacturer before any testing begins, preferably with delivery of the test vehicle(s).

Data should be provided for each test scenario configuration according to the colour scheme in Figure 5-1 for ACC HCRs 50 to 90 km/h and ACC HCRb 50 km/h and 80 km/h. In case of the maximum vehicle speed being less than 90 km/h, the manufacturer must advise of this speed and indicate the predicted performance according to the nearest speed colour scheme.

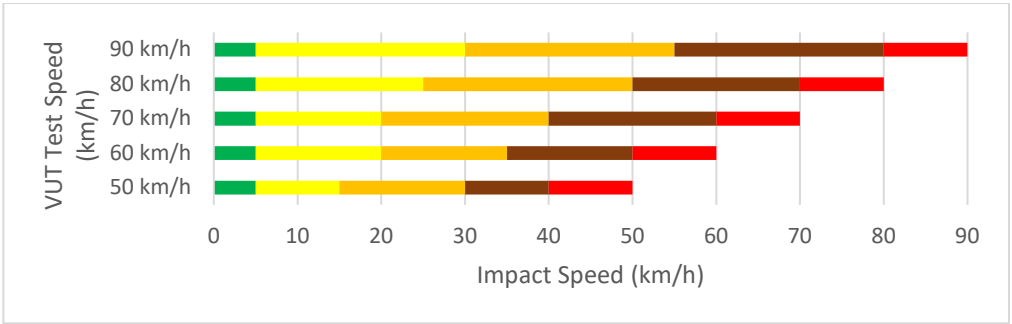


Figure 5-1 ACC HCRs and HCRb predicted performance

6 TEST CONDITIONS

6.1 Test Track

6.1.1 Paved Surface

Conduct tests on a dry (no visible moisture on the surface), uniform, solid-paved surface with a consistent slope between level and 1 % in all directions. The test surface shall have a minimal peak braking coefficient (PBC) of 0.9.

The surface 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 5.0 m to either side of the centre of the test lane and with a longitudinal distance of 20.0 m ahead of the VUT from the point after the test is complete.

6.1.2 Lane Markings

The tests described in this document require use 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 3.7 m.

The lane markings should be sufficiently long to ensure that there is at least 20.0 m of marking remaining ahead of the vehicle after the test is complete.

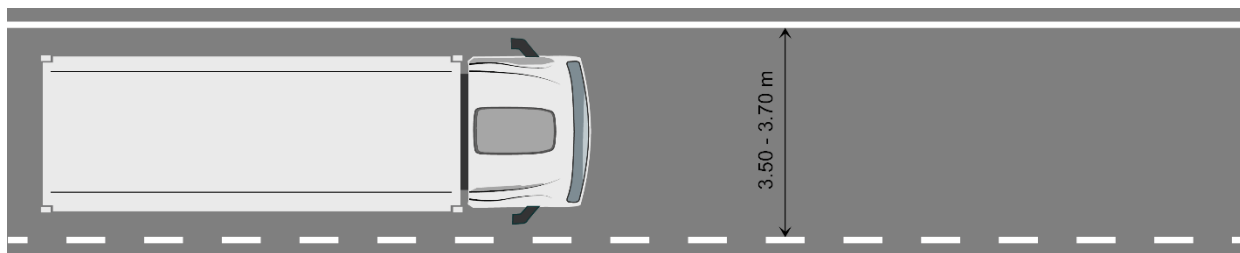


Figure 6-1 Example lane marking layout

6.1.3 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 1 km. The mean wind speed measured at a height of at least 1.0 m above the ground shall be less than 6.0 m/s with gusts not exceeding 10.0 m/s.

Natural ambient illumination must be homogenous in the test area and in excess of 2,000 lux for daylight testing with no strong shadows cast across the test area other than those caused by the VUT or GVT. 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:

- Ambient temperature in °C
- Track Temperature in °C
- Wind speed in m/s
- Wind direction in azimuth ° and/or compass point direction
- Ambient illumination in Lux

6.1.4 Surroundings

Conduct testing such that there are no other vehicles, highway furniture, obstructions, other objects or persons protruding above the test surface that may give rise to abnormal sensor measurements within a lateral distance of 5.0 m to either side of the test path during the full duration of the test starting at T_0 and within a longitudinal distance 20.0 m ahead of the VUT when the test ends.

Test areas where the VUT needs to pass under overhead signs, bridges, gantries or other significant structures are not permitted.

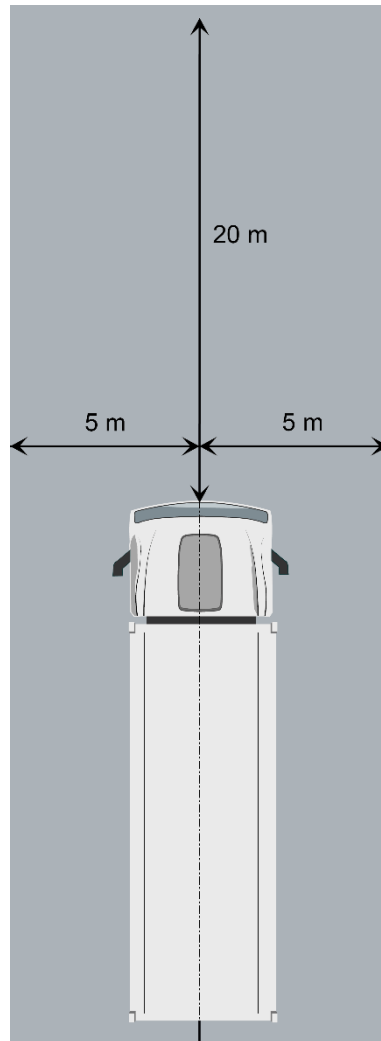


Figure 6-2 Free surroundings

The general view ahead and to either side of the test area shall comprise of a wholly plain man-made or natural environment (e.g. further test surface, plain coloured fencing or hoardings, natural vegetation or sky etc.) and must not comprise any highly reflective surfaces or contain any vehicle-like silhouettes that may give rise to abnormal sensor measurements.

6.2 VUT Preparation

6.2.1 System Settings

Set the ACC configurable following setting of the system to the closest following setting. The AEB must remain active to support avoiding a collision with the GVT.

6.2.2 Deployable Pedestrian/VRU Protection Systems

Where the vehicle is equipped with a deployable pedestrian/VRU protection system, this system shall be deactivated before the testing commences.

6.2.3 Semi-Trailer for Drawing Vehicle

For a VUT that is a prime mover tractor unit intended for drawing a semi-trailer, complete testing with the VUT coupled to an appropriate semi-trailer of the following specification:

- Of length and height approaching but not exceeding the maximum permitted by Annex 1 of Directive 96/53/EC
- Equipped with a three axle bogie (lift and/or steer axles are permitted to aid manoeuvrability however all axles must be deployed in their regular operating position during testing)
- Of adequate gross trailer mass to fulfil the gross train mass of the VUT
- With a flat floor i.e. not stepped, gooseneck or double deck
- With curtain side body in plain colour without branding
- Suitable for 5th wheel height of the VUT
- Equipped with disc brakes, an UN ECE Regulation 13 Category 1 Antilock Braking System (ABS) and an Electronic Braking System (EBS)
- Equipped with super single tyres (385/65R22.5) in good condition corresponding to the new original fitment tyres of the make, model, size, speed and load rating as specified by the trailer manufacturer
- Maintained in a fully operational condition in accordance with the manufacturer's documentation and specifications with supporting evidence



Figure 5-3 Example of a suitable trailer for testing

For the purpose of determining drawing vehicle and trailer loading, a nominal trailer mass of 6,700 kg is considered. Weigh the trailer used for testing and account for any variation from the nominal trailer mass when applying the load as illustrated in 6.2.6.

6.2.4 Tyres

Perform the testing with good condition original fitment tyres of the make, model, size, speed and load rating as specified by the vehicle manufacturer. Use inflation pressures corresponding to the manufacturer's instructions for the appropriate loading condition.

Run-in tyres according to the tyre conditioning procedure specified in 7.1.3. After running-in maintain the run-in tyres in the same position on the vehicle for the duration of the testing.

6.2.5 Running Order

Confirm that all VUT safety and operational systems are functioning correctly with no warning messages or indicators displayed to the driver. Rectify any faults before commencing testing.

Set any configurable driving controls (except for the ACC following setting) to their automatic setting e.g. ride height setting. If an automatic setting is not available, set to a middle setting.

When driven on the test track with the steering control centrally aligned, ensure the VUT exhibits good straight line driving order. In case of unsatisfactory driving order, the test laboratory should undertake remedial work to return the geometry to within the OEM tolerances and confirm good driving order.

6.2.6 Loading and Vehicle Preparation

Complete testing with the VUT half laden by mass to represent average category N vehicle operation. The procedure to prepare the VUT load requirement for testing is:

- If applicable, fill up the tank with fuel to at least 90% of the tank's capacity of fuel, or in case of large tank capacity, partially fill the tank with adequate fuel to perform the testing, noting the fuel level and the vehicle manufacturer specified tank capacity
- Check that the levels of all fluids are within operating limits and top up where necessary
- Ensure that the VUT has all its bodywork and spare wheel on board, if fitted, along with any equipment or tools supplied. Nothing else should be in the VUT
- Ensure that all tyres are inflated according to the manufacturer's instructions for the appropriate loading condition
- Measure the VUT axle masses (without trailer for a drawing vehicle – unladen test trailer mass to be determined separately) to determine the 'measured kerb mass'
- If applicable, calculate the total mass including full fuel tank (accounting for absent fuel as necessary) and for drawing vehicles, adding the 'nominal trailer mass' in 6.2.3
- The total mass is the 'unladen kerb mass' of the VUT. Record calculation details and this mass in the test details
- Determine the 'maximum permitted mass' for the VUT as the lesser of:
 - The vehicle manufacturers maximum design mass, or
 - The maximum permitted mass of the relevant vehicle or vehicle combination that is legally compliant for international transport under the terms of Annex 1 of Directive 96/53/EC
- Note the 'maximum permitted mass' must include any applicable allowance to compensate for the mass of equipment associated with alternative fuel or zero emission technologies, clearly identified from a section on the vehicle plate titled 96/53/EC article 10b compliant
- Calculate the 'nominal as tested mass' as follows:

$$\text{Nominal as tested mass} = (\text{unladen kerb mass} + \text{maximum permitted mass}) / 2$$

- Calculate the 'load mass' required to achieve the 'nominal as tested mass', accounting for absent fuel, and for drawing vehicles, any difference between the 'nominal trailer mass' and 'actual test trailer mass'

Load mass = nominal as tested mass - measured kerb mass - actual test trailer mass

- Apply the 'load mass' to the vehicle comprising of the occupant(s), test equipment (i.e. on-board test equipment and instrumentation, associated cables, cabling boxes and power sources) and ballast, density of no less than 1,000 kg/m³, placed directly on the load bed
- Locate the centre of mass of the ballast centrally within the cargo space (longitudinally and laterally) as far as is as practically possible. Ballast must be securely attached to the VUT and regularly checked during testing to confirm security. If water is used as ballast, it should be used in full containers to prevent the movement under acceleration
- Measure the VUT axle masses with the occupant(s), test equipment and ballast on board and determine the 'as tested mass', confirming that individual axle weights do not exceed their permitted maximums
- The difference between the 'actual as tested mass' and the 'nominal as tested mass' shall be no more than the lesser of $\pm 2.5\%$ of the VUT maximum permitted mass or ± 500 kg

Verify the xy coordinates for the virtual front end vehicle contour given by the manufacturer. When the coordinates given are within 10 mm of those measured by the test laboratory, the coordinates as provided by the manufacturer will be used. When the coordinates are not within 10 mm, the coordinates as measured by the laboratory will be used.

7 TEST PROCEDURE

7.1 VUT Pre-test Conditioning

7.1.1 General

A vehicle with all available safety equipment is used as delivered to the test laboratory. It may have been used for other Euro NCAP Safe Driving and Crash Avoidance tests.

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

7.1.2 Brakes

Condition the vehicle's brakes in the following manner (if it has not been done before for another test or in case the laboratory has not performed 100 km of driving) to ensure they are neither brand new nor corroded. Before commencing the next brake conditioning run, confirm the temperature of the hottest brake rotor is less than 400 °C, or wait a minimum of 120 seconds between runs to prevent brake overheating.

- Perform ten stops from a speed of 56 km/h with an average deceleration of approximately 0.2 to 0.3 g
- Immediately following the series of 56 km/h stops, perform three additional stops from a speed of 72 km/h, each time applying sufficient force to the pedal to operate the VUT antilock braking system (ABS) for the majority of each stop
- Immediately following the series of 72 km/h stops, drive the vehicle at a speed of approximately 72 km/h for five minutes to cool the brakes

7.1.3 Tyres

Condition the vehicle's tyres in the following manner (if it has not been done before for another test or in case the laboratory has not performed 100 km of driving) to remove the mould sheen,

- Drive around a circle of 100 m in diameter at a speed sufficient to generate a lateral acceleration of approximately 0.1 to 0.2 g for three clockwise laps followed by three anticlockwise laps
- Immediately following the circular driving, drive four passes at 56 km/h, performing ten cycles of a sinusoidal steering input in each pass at a frequency of 1 Hz and amplitude sufficient to generate a peak lateral acceleration of approximately 0.1 to 0.2 g
- 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.

7.1.4 System Check

Before any testing begins, perform a maximum of ten runs at the lowest test speed the system is supposed to work, to ensure proper functioning of the system.

7.2 Test Scenarios

7.2.1 ACC General

The performance of the ACC system is assessed in the HCRs and HCRb scenarios as shown in Figure 7-1 and Figure 7-2 respectively

For each test, the VUT shall be driven centrally in a fully marked lane with the indicated ACC speed set to the required test speed (not the GPS speed). In case of the maximum VUT speed being less than 90 km/h, the laboratory must test up to the maximum speed with a tolerance of - 2 km/h.

For testing purposes, assume a straight line path equivalent to the centreline of the lane in which the collision occurred, 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.

7.2.2 ACC HGV-to-Car Rear Stationary (ACC HCRs)

The ACC HCRs scenario is a combination of a range of approach speeds in 10 km/h incremental steps and impact locations with a stationary GVT, as shown in Figure 7-1.

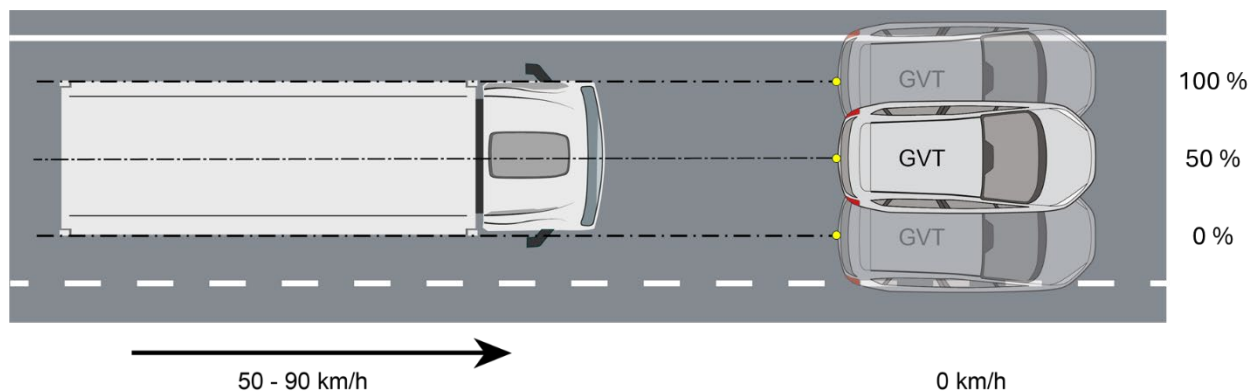


Figure 7-1 ACC HCRs scenario

7.2.3 ACC HGV-to-Car Rear Braking (ACC HCRb)

ACC HCRb tests are performed with the VUT and GVT travelling at fixed speeds of 50 and 80 km/h with a 50 % impact location with the GVT, with all combinations of 2 and 6 m/s² deceleration, as shown in Figure 7-2. Set the indicated VUT ACC set speed at the GVT speed + 5 km/h to ensure stable following. Ensure a stable headway is achieved as controlled by the ACC of the VUT for at least 4.0 seconds with less than 1.0 m variation in headway ahead of GVT braking.

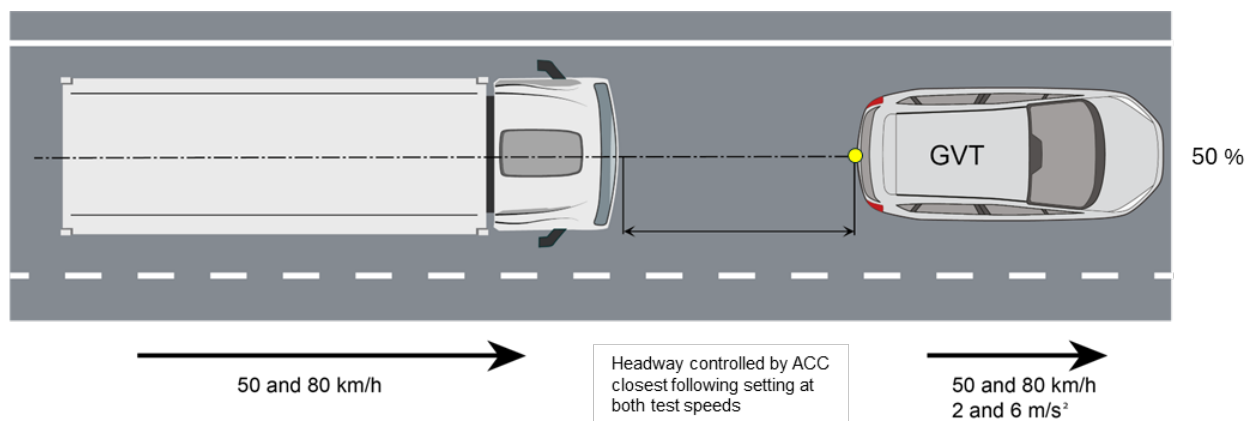


Figure 7-2 ACC HCRb scenario

The desired deceleration of the GVT shall be reached within 1.0 seconds ($T_0 + 1.0s$) which after the GVT shall remain within ± 0.5 km/h of the reference speed profile, derived from the desired deceleration, until the GVT speed equals 1 km/h.

7.2.4 Close Follow Distance Warning

The presence of a close follow distance warning is investigated by driving the AEB HCRb scenario steady state approach phase replicating a period of time equivalent to 4.0 seconds before T_0 for the 50 km/h 12 m headway and 80 km/h 30 m headway tests. Do not activate ACC during the 4.0 second window of this test. For this test it is not necessary to trigger the GVT deceleration, only the steady state close following phase is of interest for identifying the presence of a close follow distance warning.

7.3 Test Conduct

Before every test run, drive the VUT around a full circular path, and then manoeuvre the VUT into position on the test path. If requested by the OEM an initialisation run may be included before every test run. Bring the VUT to a halt and push the brake pedal through the full extent of travel and release.

For vehicles with an automatic transmission select D. For vehicles with a manual transmission select the highest gear where the RPM will be at least 1000 at the test speed. Apply only minor steering inputs as necessary to maintain the VUT tracking along the test path.

For ACC testing, when the outcome is collision avoidance or substantial speed reduction, proceed to the next test speed. Stop testing when, for two consecutive test speeds, the speed reduction observed is less than 5 km/h or the relative impact speed is greater than 20 km/h.

Before commencing the next test run, confirm the temperature of the hottest brake rotor is less than 150 °C. It is acceptable to wait for brake cooling to occur between test runs. Forced cooling is permitted with ambient air only.

Between tests, avoid riding the brake pedal and harsh acceleration, braking or turning unless strictly necessary to maintain a safe testing environment.

7.4 Test Execution

Accelerate the VUT and GVT to their respective test speeds.

The test shall start at T_0 (4s TTC) and is valid when all boundary conditions are met between T_0 and T_{ACC} or any other system intervention:

- | | |
|--|---------------------------|
| - Speed of VUT (GPS-speed) | Test speed + 1.0 km/h |
| - Speed of GVT (GPS-speed) | Test speed $\pm$ 1.0 km/h |
| - Lateral deviation from test path for VUT | 0 ± 0.10 m |
| - Lateral deviation from test path for GVT | 0 ± 0.10 m |
| - Relative distance between VUT and GVT (HCRb) following setting | Controlled by ACC closest |
| - Yaw velocity of VUT | 0 ± 1.0 °/s |
| - Steering wheel velocity | 0 ± 20.0 °/s |

In case of the unanticipated withdrawal of automatic braking during an ACC system test, investigate the steering wheel velocity after T_{ACC} . If the steering wheel velocity exceeds the 0 ± 20.0 °/s limit after T_{ACC} repeat the test taking measures to maintain the steering wheel velocity within the limit.

The end of a test is considered when one of the following occurs:

- $V_{VUT} = 0$ km/h
- $V_{VUT} < V_{GVT}$
- T_{impact}

There shall be no operation of other driving controls during the test e.g. accelerator, brake or clutch pedal.

If during the execution of a test run it can be confidently predicted that V_{impact} would be in the red colour band for the test speed, it is permitted to end the test and take evasive action to avoid a collision in the interest of preserving the VUT and GVT.