EURO NCAP

#FORSAFERTRUCKS

Version 1.0
May 2024

Safe Driving Vision

Test Protocol

Implementation November 2024

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.

CONTENTS

DEFINITIONS

Throughout this protocol the following terms are used:

A-pillar – means any roof support forward of the vertical transverse plane located 68mm in front of the V Point and includes non-transparent items such as windscreen mouldings and door frames, attached or contiguous to such a support.

Accelerator Heel Point (AHP) – means the lowest point at the intersection of the heel of the foot and the floor of the vehicle, with the shoe positioned on the Undepressed Accelerator Pedal.

Assessment volume – means the volume of space around the forward part of the vehicle where visibility of part of a vulnerable road user will be considered to contribute to the measurement of the vehicle's direct vision performance.

Camera Monitor System – means a system comprising of camera(s) and display screen(s) that provide the driver with indirect vision to the front, side(s) and/or rear of the vehicle.

Direct Vision – means the field of vision from the driver's eye point that can be seen without the aid of indirect vision devices such as mirrors or cameras.

Direct Vision Opening Line – means the intersection of a surface with a sight line that is positioned at a tangent to the first vision occlusion that would obstruct that sightline (e.g. A-pillar, lower edge of windscreen, steering wheel windscreen wipers, etc.). See the Figure in Annex 7 for an illustration of the process.

Driver's eye point or E-point – means a point representing the midpoint between the centre of the driver's left and right eye.

Frontal plane – means the plane perpendicular to the median longitudinal plane of the vehicle and touching its foremost point, disregarding the projection of devices for indirect vision and any part of the vehicle more than 2.0 m above the ground.

H-point Manikin – means a three-dimensional H-Point Machine as defined in Annex 1 of the Consolidated Resolution on the Construction of Vehicles (R.E.3).

Intended cab mounting angle – means the pitch and roll angle of the cab floor relative to a horizontal plane with the cab in its nominal design condition.

Nearside – means the right side of the vehicle for right-hand traffic or the left side of the vehicle in left-hand traffic.

Nearside Plane – means the plane parallel to the median longitudinal plane of the vehicle and touching its most outboard point in the nearside direction forward of a position 1.0 m behind the driver ocular reference point, disregarding the projection of devices for indirect vision and any part of the subject vehicle higher than 2.0 m above the ground.

Offside – means the left side of the vehicle for right-hand traffic, or the right side of the vehicle for left-hand traffic.

Offside Plane – means the plane parallel to the median longitudinal plane of the vehicle and touching its most outboard point in the offside direction forward of a position 1.0 m behind the driver ocular reference point, disregarding the projection of devices for indirect vision and any part of the subject vehicle higher than 2. 0m above the ground.

P-point – means the point about which the driver's head rotates when viewing objects on a horizontal plane at eye level. It is located 98 mm rearward of E2 in the X axis.

R-point – means the seating reference point as defined in Annex 1 of the Consolidated Resolution on the Construction of Vehicles (R.E.3).

Sightline – means a straight line representing the driver’s line of sight from an eye point either to a target point or at any particular defined angle within the three-dimensional reference system.

Total Visible Volume – means a volume of space, contained entirely within the assessment volume, that is visible via sightlines projected from one of the E-Points through the direct vision opening lines. It is the sum of volumes visible within the assessment zone from the drivers eye point through any window in the vehicle cab.

Transparent area – means that area of a vehicle windscreen or other glazed surface, if fitted, that permits light transmittance measured in a direction perpendicular to the surface of not less than 70 per cent, excluding any dot printed area of opaque obscuration.

Vehicle under test (VUT) – means the vehicle tested according to this protocol.

Vision occlusion – means any permanently fitted part of the structure of the vehicle, or of the interior of the driver’s cabin, that would obstruct a sightline passing from any of the three defined E-Points to any part of the assessment volume.

1 INTRODUCTION

Collisions between Vulnerable Road Users (VRU) and large commercial vehicles that are undertaking low speed manoeuvres, such as a turn to the nearside or moving off from rest, typically occur at low driving speeds. They usually have serious consequences for VRU.

The cause of this type of collision can be contributed to by many factors. The VRU may have been positioned in a blind spot where they could not be seen directly through the windows or via mirrors. Alternatively, they may have been available to be seen during the build-up to the collision, but the driver may have detected their presence too late to avoid collision or may have failed to detect their presence at all. This late detection, or failure to detect, could be a result of the driver failing to look, looking but failing to see, or seeing but failing to correctly judge the risk.

Aligned with these multi-factor causes, there are also a number of potential solutions to the problem, including the eliminating of blind spots, increasing the areas that can be seen directly through the windows, blind spot information systems, collision warnings and automated intervention to either stop, if moving already, or to prevent movement if stationary and a collision with a vulnerable road user would otherwise be imminent.

In some circumstances, the different solutions will offer synergies. An effective collision warning can alert an attentive driver to the existence of a problem, but that driver is more likely to respond quickly and appropriately if the warning draws their attention to the presence of a VRU that is clearly visible by direct line of sight through a window, rather than to a small, distorted image of the VRU in a blind spot mirror, or where the VRU is not visible at all.

At the other end of the scale, where a moving off from rest collision occurs purely because the VRU was completely invisible to a largely attentive driver who just failed to check the class VI front mirror, then the collision would certainly be avoided by improved direct vision. It would also be certain to be avoided if the vehicle detected the presence of the VRU and prevented motion automatically. The VRU cannot be saved twice and in this circumstance, the benefits are not additive.

Euro NCAP recognises this complexity and has implemented test protocols intended to drive vehicles towards high standards of vision as well as towards high performance collision avoidance systems. These will be applied flexibly in the rating so that manufacturers can choose the most cost-effective way of solving the problems in their specific freight application and vehicle design.

This protocol specifies the HGV direct and indirect vision test procedures, which are used to evaluate vision in a repeatable and reproducible manner for the HGV safety rating scheme.

2 REFERENCE SYSTEM

2.1 Convention

For the VUT and 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.

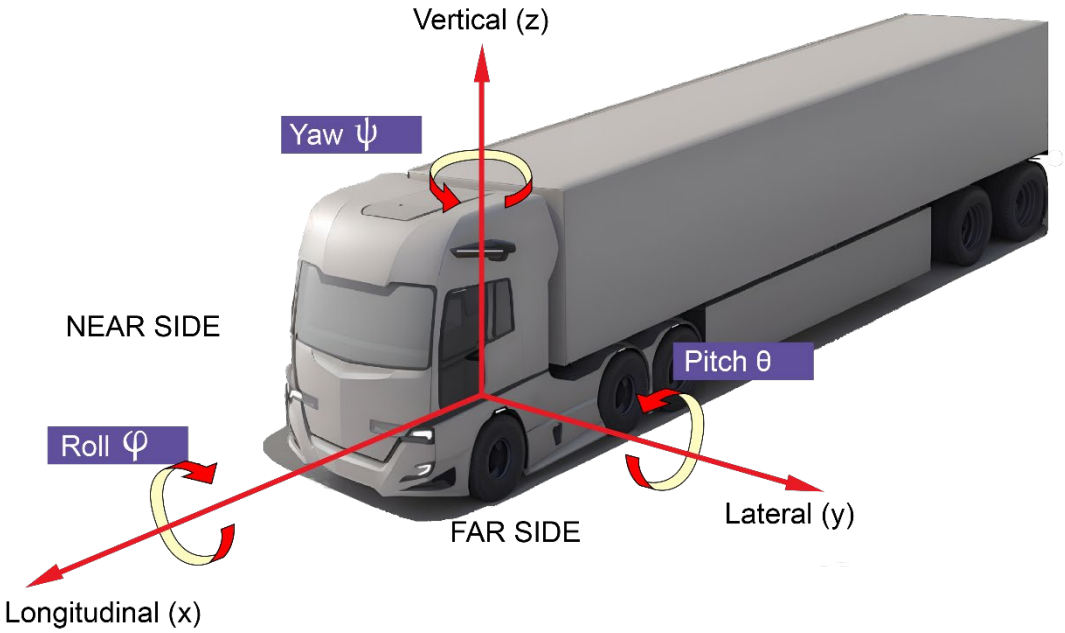

Figure 2-1 Coordinate system and notation (LHD & RHD) and near side – far side for LHD vehicle

2.2 Definition of the Assessment Volume

The assessment volume shall be defined as the volume of space between the frontal, nearside and offside plane of the vehicle and the horizontal and vertical boundaries of the assessment zone as defined below and illustrated in Figure 5-1:

- The forward boundary of the assessment zone shall be formed by a plane parallel to the vehicle frontal plane and positioned 2,000 mm forward of the vehicle frontal plane.
- The nearside boundary of the assessment zone shall be formed by a plane parallel to the vehicle nearside plane and positioned 4,500 mm further to its nearside.
- The offside boundary of the assessment zone shall be formed by a plane parallel to the vehicle offside plane and positioned 2,000 mm further to its offside.
- The rearward boundary of the assessment zone shall be formed by a plane parallel to the vehicle frontal plane and positioned 1,000 mm behind the driver's eyepoint (E2).
- The vertical boundaries of the assessment zone shall be formed by the ground plane and a plane parallel to the ground plane but positioned 1,602 mm above the ground.

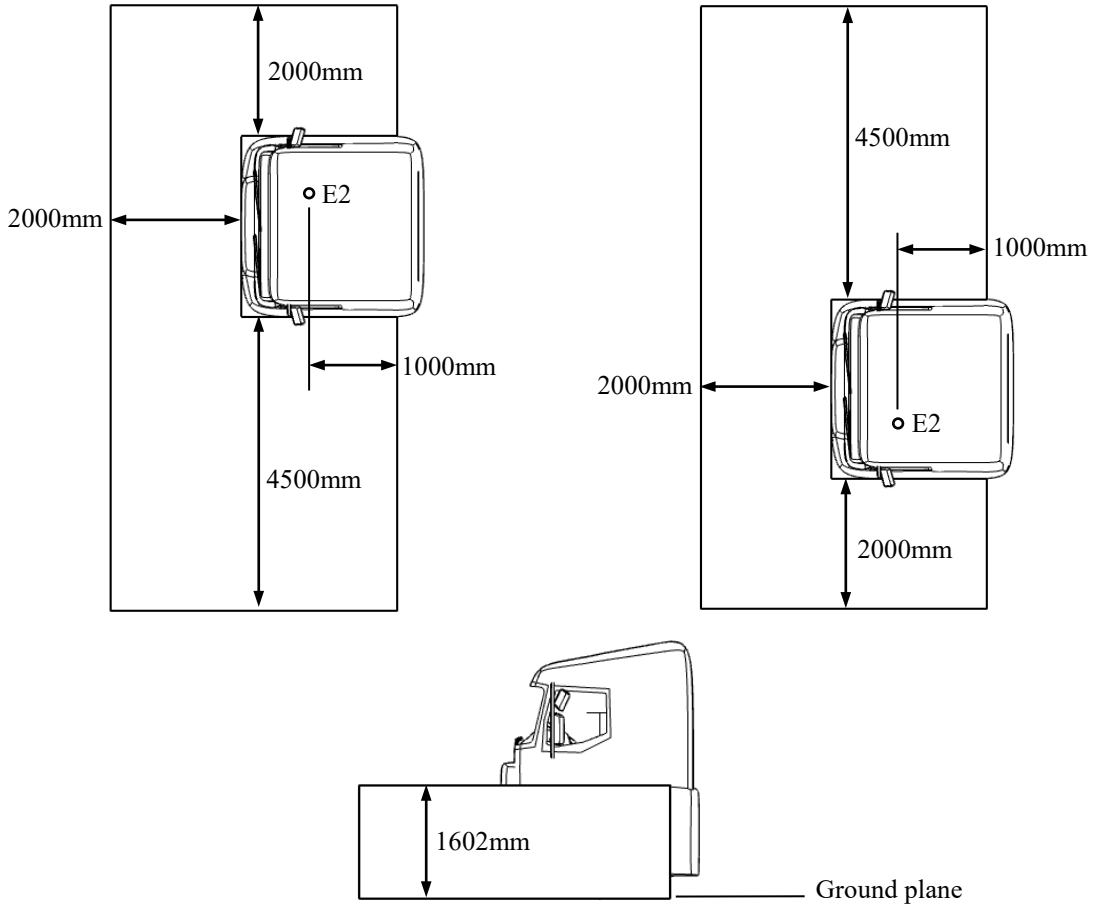

Figure 5-2 Definition of the assessment volume plan view for RHD vehicle (top left), plan view for LHD vehicle (top right), side view (bottom)

2.3 Definition of the Driver’s Eye Point

Three separate eye points are defined. E2 is the forward eye point, E1 is the left-side eyepoint and E3 is the right-side eyepoint.

Each point is defined using the three-dimensional reference system. E2 is defined by an offset from the accelerator heel point of 1,163.25 mm in the Z axis, and 678 mm rearward in the X axis. The position of E2 in the Y axis is on a vertical plane, parallel to the median longitudinal plane and passing through the centre of the driver's seat. Points E1 and E3 are defined by a 60° rotation, to the left and right respectively, about the P-Point.

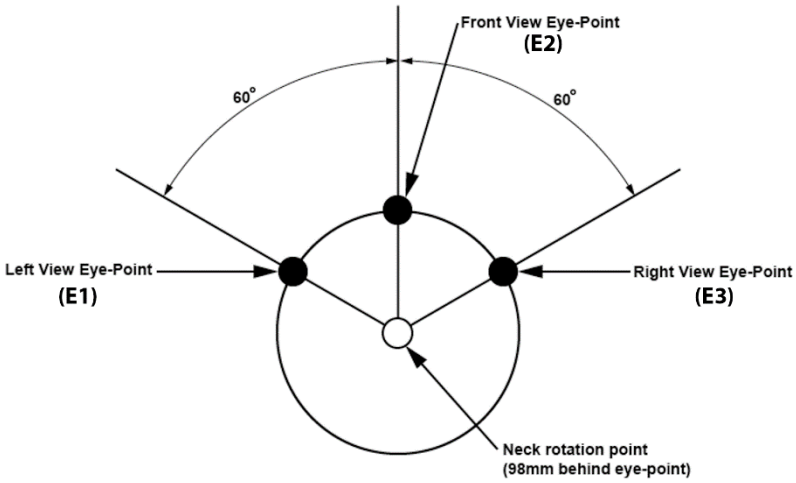

Figure 5-3 Definition of the Driver’s eye points for views to the front, left and right

3 TARGET SYSTEMS

Conduct the tests in this protocol using the Euro NCAP Pedestrian Target (EPTa and EPTc) and Euro NCAP Bicyclist and bike Target (EBT) dressed in a black shirt and blue trousers, as shown in Figure 4-1. The EPT and EBT replicate the visual, radar, LIDAR and PMD attributes of a typical pedestrian and bicyclist respectively and is impactable without causing significant damage to the VUT.

Figure 4-1 Euro NCAP Pedestrian Target (adult and child) and Bicyclist and bike Targets (EPTa, EPTc and EBT)

To ensure repeatable results, the propulsion system and VRU target must meet the requirements as detailed in ISO 19206 Road vehicles — Test devices for target vehicles, vulnerable road users and other objects, for assessment of active safety functions:

- Part 2:2018: Requirements for pedestrian targets (articulated targets only)
- Part 4:2018: Requirements for bicyclist target

The EPT and EBT are designed to work with the following types of sensors:

- Radar (24 and 76 to 81 GHz)
- LIDAR
- Camera
- Ultrasonic sensors

When a manufacturer believes that the EPT or EBT 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.

4 TEST CONDITIONS

4.1 VUT Preparation

4.1.1 Heel Point

The Accelerator Heel Point shall be measured in accordance with Recommended Practice SAE J1100 Rev. 2009 using the H-Point Manikin. The foot angle (A46) shall be at a minimum of 87° when the H-Point manikin is positioned at the R-Point. For vehicles with R-Point to heel vertical (H30) greater than 405 mm, the accelerator pedal may be depressed as specified by the manufacturer. If the depressed pedal is used, the foot must be flat on the accelerator pedal.

4.1.2 Loading and Vehicle Preparation

The vehicle shall be assessed with the accelerator heel point positioned at a height from the ground that is no lower than the midpoint between the height that the manufacturer calculates it would be at for an unladen chassis cab (without body) and that which the manufacturer calculates it would be at when the vehicle is loaded to its technically permissible design maximum.

Note: Where a manufacturer does not supply the expected direct vision score, Euro NCAP reserve the right to evaluate the vehicle in a half laden condition with 'as tested' mass as follows:

As tested mass = Unladen kerb mass + ((GVW – Unladen kerb mass) / 2)

- The vehicle cab shall be positioned at the intended mounting angle. It is permitted to drive the vehicle for a short distance in order to settle the cab suspension if requested by the manufacturer.
- The steering wheel shall be located in the centre of the possible range, considering all axes of adjustment.
- Devices for indirect vision (where applicable) shall be adjusted to meet the fields of vision required by UN Regulation No. 46 where the eye points are as defined in Figure 5-2.
- If a passenger seat is fitted and the position of the seat is adjustable, the passenger seat shall be placed at its rearmost lowest position with a backrest angle of 18 ° from vertical.
- Where the selected passenger seat is foldable, the vehicle may be assessed with the seat in the in-use (deployed) or the not-in-use (stowed) position at the discretion of the manufacturer. The single selected seat position shall be applied throughout the whole assessment.
- Where armrests are adjustable these may be in the in-use (deployed) or the not-in-use (stowed) position at the discretion of the manufacturer.
- Head restraints shall be in the lowest position suitable for normal use in service. They shall not be in a position provided solely for stowage when not in use.
- 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.
- Set any configurable driving controls to their automatic setting e.g. ride height setting. If an automatic setting is not available, set to a middle setting.

5 TEST PROCEDURE

5.1 Test Scenarios

5.1.1 Direct Vision

The visible volume shall be quantified according to one of two methods: A virtual test in accordance with Annex 7 of UNECE Regulation 167 or a physical test in accordance with Annex 6 of UNECE Regulation 167. If the manufacturer supplies evidence of the result of such an assessment, then this will generally be accepted by Euro NCAP, though the right is reserved to independently spot check any manufacturer supplied result.

Where a manufacturer does not supply a score, the test laboratory will undertake the testing in accordance with either of the two methods above.

Test laboratories must ensure that illustrative photographs and video footage are available to clearly and consistently between vehicles show the ease or difficulty with which vulnerable road users positioned around the vehicle can be seen. The Euro NCAP pedestrian and bicyclist dummies shall be used for this purpose.

The visible volume will be translated into a performance score based on a stepped scale.

5.1.2 Indirect vision

Indirect vision systems, such as Camera Monitor Systems (CMS) and other novel indirect vision technologies, that cover the regulatorily prescribed Class II, IV V and VI areas and other areas, will be assessed on a feature basis:

- CMS class II and IV view
  - With markings showing the rear of the vehicle and safe distances behind
  - With panning maintaining a view of the VUT and trailer (if applicable) rear axle cut in when turning
  - With enhanced nighttime vision not compromising image quality e.g. infrared illumination
- CMS class V view
- CMS class VI view
- Other novel CMS views and/or features illustrated by the manufacturer