EURO NCAP

#FORSAFERCARS

Version 0.9
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Safe Driving & Crash Avoidance

Virtual Testing

Supporting Protocol

Implementation January 2026

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

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).

CONTENTS

DEFINITIONS

Throughout this protocol the following terms are used (listed in alphabetical order):

Perfect perception - This means that all objects have a 100% existence probability and appear once they are classified as by the physical sensors in the idealised Field-of-View of relevant sensors.

1 INTRODUCTION

An OEM can use virtual testing to provide input to Safe Driving and Crash Avoidance performance predictions. Where virtual testing is (partly) used, the OEM shall use the following process.

1. Qualification of simulation model by OEM
    i. OEM dossier with simulation set-up, model details, sensor details, etc.
    ii. In-house qualification between virtual and physical testing for CCR and CPNCO scenarios using ISO score and defined KPI's
2. Virtual testing by OEM to generate colour predictions for Safe Driving and Crash Avoidance, where applicable
3. Physical verification testing by Euro NCAP
    i. Randomly selection of scenarios for spot testing by Euro NCAP
    ii. OEM provides virtual test data for selected scenarios
    iii. Physical testing of selected scenarios by Euro NCAP
4. Validation of virtual test data
    i. ISO score and KPI's are determined
    ii. Overall acceptance is calculated
5. Possible re-simulation by OEM in case the validation of the virtual test data does not meet the requirements.

It should be noted that text and/or values shown in square brackets […] need to be confirmed based on additional data.

2 REFERENCE SYSTEM

2.1Convention

Use the convention specified in ISO 8855:1991, with the origin at the most forward point on the centreline of the VUT for dynamic data measurements as shown in Figure 2-1. This reference system should be used for both left- and right-hand drive vehicles. In Figure 2-1 nearside and far-side are shown for a left-hand drive vehicle. For a right-hand drive vehicle, nearside and far-side are swapped.

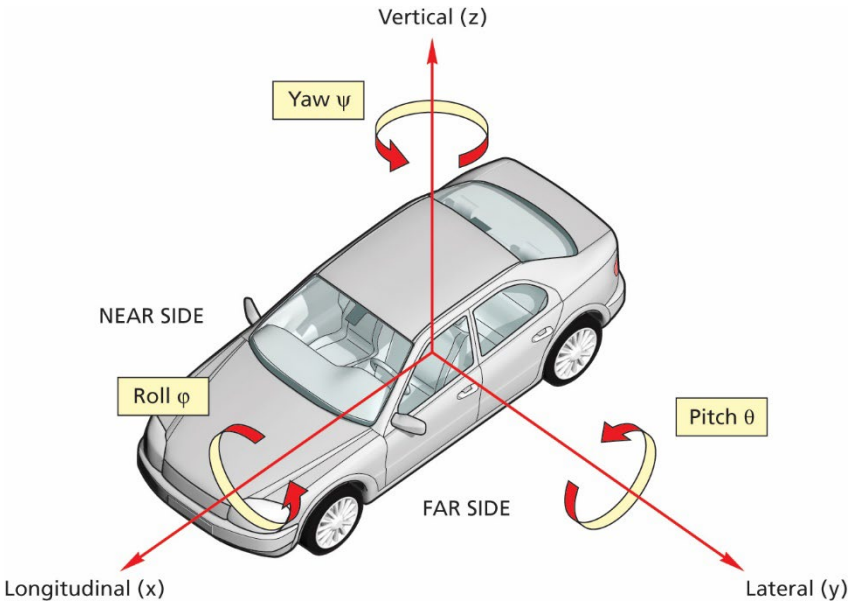

Figure 2-1 Coordinate system and notation

3 SIMULATION DATA

All simulation results must be uploaded in the prescribed format to the Euro NCAP VTA server by the OEM. Euro NCAP will make parameterised OpenScenario files available for each scenario that may be used by the OEM. Data that are not provided in the correct format or outside of physical limits, e.g. acceleration levels that can never be seen in physical tests will be rejected.

3.1 Measurements and Variables

For all required channels data between T0 and end of test as specified in the specific protocols shall be provided.

All channels must be named according to the ISO MME channel codes listed in TB021. The ISO MME codes have to be consistent between physical and virtual tests.

3.2 Data Filtering

All time series data must be provided with an output frequency of 100 Hz and no additional filtering shall be applied on the output data.

4 SIMULATION MODEL

For all simulations, the vehicle simulation model, target simulation models and environmental model must be kept the same where applicable.

Nominal values for each scenario should be used in the virtual tests and all boundary conditions as per physical test protocol should be met.

4.1 Vehicle simulation model

The relevant vehicle simulation model properties need to be representative of the vehicle under assessment, e.g. vehicle mass, width, etc.

Perfect perception can be assumed in the simulation models. All sensors used should be positioned in the correct location and the opening angles, azimuth and range should be accurate.

The function algorithm used in the virtual model should be similar as the one present in the physical vehicle.

Vehicle dynamics models can be simplified, but should include relevant dynamic characteristics for the virtual test scenarios.

4.2 Target simulation models

Virtual targets shall have the same dimensions, and bounding box where relevant, as their physical counterparts.

4.3 Environmental simulation model

The toolchain and its components shall be capable of accurately representing the relevant aspects of the physical test that is being modelled. Environmental models that are used in the simulation models should have the nominal and relevant characteristics and elements as described in the test protocols and shall be kept the same throughout the whole process.

5 QUALIFICATION OF SIMULATION MODEL

The simulation models used by the OEM will need to meet the qualification criteria detailed below.

These criteria apply for both the initial OEM in-house qualification and the spot test qualification done by Euro NCAP. For each scenario cluster, different acceptance criteria might apply as detailed in this chapter. At least [75%] of the Euro NCAP spot tests should meet the qualification criteria, otherwise the simulation dossier will not be accepted for that scenario cluster.

The qualification criteria are calculated automatically on the VT server as soon as the data is uploaded.

Physical data from test cases that are determined to be unrealistic, outside of physical limits will be excluded from the qualification.

5.1Qualification and Validation scenarios

5.1.1 OEM in-house qualification

The OEM in-house qualification is performed on the following scenarios.

- CCRs (standard matrix), at least the marked corner cases and [3-5] additional cases.

CCRs	GVT speed	Function	125%	100%	75%	50%	25%	0%	-25%
10 km/h	0 km/h	AEB		X				X	
20 km/h	0 km/h	AEB							
30 km/h	0 km/h	AEB							
40 km/h	0 km/h	AEB							
50 km/h	0 km/h	AEB							
60 km/h	0 km/h	FCW							
70 km/h	0 km/h	FCW							
80 km/h	0 km/h	FCW		X				X	

- CPNCO (standard matrix), at least the marked cases and [1] additional cases in between.

CPNCO	25%	50%	75%
10 km/h		X	
20 km/h			
30 km/h			
40 km/h			
50 km/h			
60 km/h		X	

5.1.2 Euro NCAP spot test qualification

The spot test cases will be selected by Euro NCAP after receiving the OEM predictions. [Reference to CA protocol].

5.2 Qualification Criteria

The qualification criteria used are the ISO Score and KPI's according the table below.

Qualification Criteria application	ISO Score	KPI
Standard Matrix	X	X
Extended Matrix	X	

The respective criteria must fulfil the qualification requirements as defined in 5.3.1 and 5.3.2.

5.2.1 ISO score

The ISO score, according to ISO TS 18571, of the longitudinal vehicle acceleration channel (10VEHC000000ACXS) is calculated.
Before calculating the ISO score, the time channel for the virtual test is time-shifted so that Taeb is aligned between the physical test and the simulation.

The ISO score calculation will only take into account the time series data until Tend as defined in the physical test protocols. The Tend from physical or virtual test is to be used, whichever is the earliest. KPI

For each applicable KPI, the error between physical test and simulation are calculated:

KPI_error = KPI_physical - KPI_simulation

5.3 Acceptance Criteria

Different acceptance criteria exist for the scenarios within the scenario clusters:

- **Frontal – Longitudinal**: CCR, CMR, CPLA, CBLA, CCF
- **Frontal – Turning**: CCFtap, CMFtap, CPTA, CBTA
- **Frontal – Crossing**: CCC, CMC, CPC, CBC
- **Lane – ELK**: Road Edge, Oncoming, Overtaking

5.3.1 ISO score

Scenario cluster	Acceptance criteria Standard Matrix	Acceptance criteria Extended Matrix
Frontal – Longitudinal	[0.7]	[0.5]
Frontal – Turning	[0.7]	[0.5]
Frontal – Crossing	[0.7]	[0.5]

5.3.2 KPI

Scenario cluster	KPI_error	Accepted KPI_error
Frontal – Longitudinal	TTC_AEB [s]	[+-0.2]
	TTC_FCW [s]	[+-0.2]
	Remaining distance [m]	[+-1.0]
	Impact speed [m/s]	[+-1.0]
Frontal – Turning	TTC_AEB [s]	[+-0.2]
	TTC_FCW [s]	[+-0.2]
	Remaining distance [m]	[+-1.0]
	Impact speed [m/s]	[+-1.0]
Frontal – Crossing	TTC_AEB [s]	[+-0.25]
	TTC_FCW [s]	[+-0.5]
	Impact speed [m/s]	[+-1.0]
Lane – ELK	DTLE_ELK [m]	[+-0.2]
	DTLE_LDW [m]	[+-0.2]