EURO NCAP

#FORSAFERCARS

Version 1.1
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Data Acquisition And Assessment Criteria Calculation

Safe Driving & Crash Avoidance

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PREFACE

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

1 TEST DATA

To ensure consistency in the general folder structure, this chapter details the required folder structure. For each (sub)test where measurements are performed with vehicles and/or other test equipment, all test data shall be provided in ISO-MME 1.6 format and shall be fully compliant with the ISO/TS 13499 standard. It should be noted that some file names are also prescribed in this document. All data shall be provided using SI units unless specified otherwise.

1.1 Safe Driving and Crash Avoidance

The following folder structure, generated automatically in the Euro NCAP sharing platform, is to be used for all test series where the name of the main folder containing all tests consists of:

- The year of test
- OEM abbreviation
- Euro NCAP internal number (4 digits)
- Make and Model

The next paragraph details the folder structure. On the highest level, the folder structure is as follows with on the right an example using the Volvo ES90 that is assumed to be tested in 2026 with a Euro NCAP internal number of 9999.

- Main Folder Name
  - Safe Driving
    - Occupant Monitoring_Seatbelt Usage
    - Occupant Monitoring_Occupant Classification
    - Occupant Monitoring_Occupant Presence
    - Driver Engagement_Driver Monitoring
    - Driver Engagement_Driving Controls
    - Vehicle Assistance_Speed Assistance
    - Vehicle Assistance_ACC Performance
    - Vehicle Assistance_Steering Assistance
    - Assisted Driving _Driver Monitoring
    - Assisted Driving _Driving Collaboration
  - Collision Avoidance
    - Frontal Collisions_ Car & PTW
    - Frontal Collisions_ Pedestrian & Cyclist
    - Lane Departure Collisions_ Single Vehicle
    - Lane Departure Collisions_Car & PTW
    - Low Speed Collisions_Car & PTW
    - Low Speed Collisions_Pedestrian & Cyclist

- 26-VOL-9999-Volvo ES90
  - 26-VOL-9999-SD
    - 26-VOL-9999-OM_SU
    - 26-VOL-9999-OM_OC
    - 26-VOL-9999-OM_OP
    - 26-VOL-9999-DE_DM
    - 26-VOL-9999-DE_DC
    - 26-VOL-9999-VA_SAS
    - 26-VOL-9999-VA_ACC
    - 26-VOL-9999-VA_STA
    - 26-VOL-9999-AD_DM
    - 26-VOL-9999-AD_DCOL
  - 26-VOL-9999-CA
    - 26-VOL-9999-FC_C&PTW
    - 26-VOL-9999-FC_P&C
    - 26-VOL-9999-LDC_SV
    - 26-VOL-9999- LDC_C&PTW
    - 26-VOL-9999-LSC_C&PTW
    - 26-VOL-9999-LSC_P&C

1.1.1 Test folders

The number of test folders in each of the following main folders depends on the performance of the vehicle under test. For each of the test combinations, there shall be a separate test folder. It

should be noted that the test laboratory may use the naming convention of their choice for each of the test folders.

1.1.2 Test reports

Each of the stage element folder (e.g., Occupant Monitoring_Seatbelt Usage) shall contain a test report provided by the laboratory. This document shall be detailed enough to understand the test execution, the system reaction and the laboratory judgment.

1.2 ISO MME folder structure

The ISO MME folder structure is to be applied to all applicable tests and the files contained in these folders follow the ISO/TS 13499 standard. The main directory contains two folders and one file. The following folders and files (comment files when needed in .txt format) need to be provided for every test performed, where the test number is the one as specified in the previous section.

For each file and folder (where necessary) the required contents are specified in detail in the paragraphs below.

- Test folder
  - Channel
  - Movie
  - <test number>.mme
  - <test number>.txt

1.2.1 Channel folder

The channel folder contains all channels from the vehicle and targets used in the test as defined in Section 2.

- Test folder
  - **Channel**
    - <test number>.xxx
    - <test number>.chn
  - Movie
  - <test number>.mme
  - <test number>.txt

1.2.2 Movie folder

The movie folder contains the films, using the exact names as specified in the Euro NCAP Film and Photo protocol.

- Test folder
  - Channel
  - **Movie**
    - < test number _ name of movie file 1>
    - < test number _ name of movie file m>
  - <test number>.mme
  - <test number>.txt

1.2.3 MME-file

The mme-file contains the information of the test.

- Test folder
  - Channel
  - Movie
  - **<test number>.mme**
  - <test number>.txt

The mme-file shall contain the following headers:

Item	Header	Unit	Remarks
Data format edition number	:1.6		
Laboratory name	:<Lab name>		
Customer name	:Euro NCAP		
Customer project ref. number	:<Test series number>		4 digits number, e.g. 9999
Title	:Euro NCAP <year of test>		
Timestamp	:<Date Time>		YYYY/MM/DD HH:MM:SS
Scenario	:<Scenario>		See table
Type of the test	:<Type of the test>		See table
Subtype of the test	:<Subtype of the test>		See table
Run repetition	:<Run repetition>		
Region	:<Region>		<EU/UK>
Robustness Layer	:<Type, Robustness Layer, Parameter>		See table
Name TOB 1	:<Make, Model>		
Driver position TOB 1	:<Driver position>		<1/3>, LHD=1 and RHD=3
Ref. number TOB 1	:<VIN >		
S/W version TOB 1	:<SW version>		As given by OEM
Dimensions TOB 1	:<Length, Width>	mm	Dimensions as defined in protocol
Shape Front TOB 1	:<(x1;y1), (x2;y2), (x3;y3), (x4;y4), (x5;y5) (x6;y6), (x7;y7)>	mm	Origin (x4,y4) at the most forward point on the centreline of test object 1
Shape Left Side TOB 1	:<(x8;y8), (x9;y9), (x10;y10), (x11;y11), (x12;y12)>	mm	All coordinates relative to the most forward point on the centreline of test object 1 (x4,y4) as illustrated below.
Shape Rear TOB 1	:<(x13;y13), (x14;y14), (x15;y15), (x16;y16), (x17;y17) (x18;y18), (x19;y19)>	mm	

Shape Right Side TOB 1	:<(x20;y20), (x21;y21), (x22;y22), (x23;y23), (x24;y24)>	mm	
Front overhang TOB 1	:<Front overhang>	mm	
Velocity longitudinal TOB 1	:<VUT longitudinal velocity>	km/h	Desired (scenario) velocity
Lane Departure Velocity TOB 1	:<VUT lateral velocity>	m/s	Desired (scenario) velocity
Impact side TOB 1	:<Impact side>		< NOVALUE/FR/LE/RE/RI>
Impact location TOB 1	:<Impact location>	%	Desired (scenario) impact location
Driver State TOB 1	:<Driver state>		<NOVALUE/Attentive/ Inattentive>
Name TOB 2	:<Name TOB 2>		See table
Velocity TOB 2	:<Target velocity>	km/h	Desired (scenario) velocity
Acceleration TOB 2	:<Target acceleration>	m/s^2	Desired (scenario) acceleration for breaking test cases
Heading TOB 2	:<Target heading>	°	Desired (scenario) heading
Type of data source	:<Type>		<Virtual Test/Physical Test>

Notes:

- Test Object (TOB) 1 corresponds to the vehicle under test
- When a field is not relevant for a particular test, the corresponding header should be field with “NOVALUE”
- the non-standard attributes need to be preceded by a point “.xxx”

1.2.3.1 Scenario, type of test and condition of test

Scenario	Type of the test	Subtype of the test
CCRs	:<AEB/FCW/AES/ESS>	:NOVALUE
CCRm	:<AEB/AES >	:NOVALUE
CCRb	:<AEB/AES >	:NOVALUE
CCFhos	:<AEB/AES >	:NOVALUE
CCFhol	:<AEB/AES >	:NOVALUE
CMRs	:<AEB/AES/ESS>	:NOVALUE
CMRb	:<AEB/AES >	:NOVALUE
CPLA	:<AEB/FCW/ESS>	:<D/N>
CBLA	:<AEB/FCW/ESS>	:NOVALUE
CCFtap	:<AEB>	:NOVALUE
CMFtap	:<AEB>	:NOVALUE
CPTA	:<AEB>	:<fs/ns/fo/no>
CBTA	:<AEB>	:<fs/ns/fo/no>
CCCscp	:<AEB>	:NOVALUE

CMCscp	:<AEB>	:NOVALUE
CPNA	:<AEB >	:<D/N>
CPFA	:<AEB>	:<D/N>
CPNCO	:<AEB/AES>	:<D/N>
CBNA	:<AEB>	:NOVALUE
CBFA	:<AEB>	:NOVALUE
CBNAO	:<AEB>	:< NOVALUE/Li>
ELK-RE	:NOVALUE	:NOVALUE
ELK-ON	:NOVALUE	:NOVALUE
ELK-OV	:NOVALUE	:<U/I>
CPMRC	:NOVALUE	:<Li>
CPMFC	:NOVALUE	:<D1/D2>
CBDA	:<i/w/r>	:<Li>
DA-OT	:NOVALUE	:NOVALUE
DA-CI	:<RE/SL/DL>	:<ON/OFF>

For the parameter Li, the index “i” should be reported into the subtype of test header according to the following table:

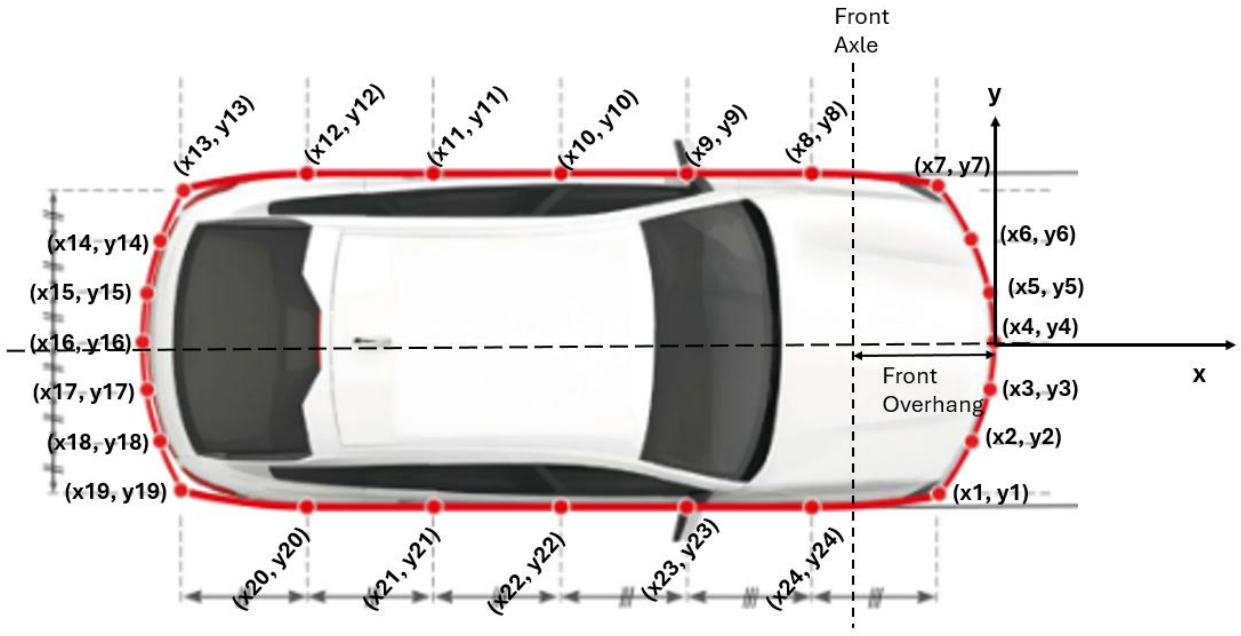
Header	Corresponding rear gap
L1	0.5 m
L2	1 m
L3	1.5 m
L4	2 m
L5	2.5 m

1.2.3.2 Robustness layers

Type	Robustness Layer		Parameter
	Name	Code	
None	Not applicable	NOVALUE	No robustness layer applied
VUT	Driver input pre-crash	DI	
Target	Speed	S	<adjusted target velocity in km/h>
	Acceleration	A	<adjusted target acceleration in m/s^2>
	Initial position offset	IP	<adjusted target position offset in m>
	Trajectory/Heading	H	<adjusted target heading in degrees>
Environment	Illumination (Nighttime)	N	
	Illumination (Headlamp Glare)	HG	TBD (from CA 002)
	Infrastructure/Clutter	I	TBD (from CA 002)
	Obscuration/Obstruction	O	TBD (from CA 002)

1.2.3.3 Shape of test object 1

The shape of the VUT, as defined in the test protocols, is characterized by 24 distinct points. They shall be defined in the coordinate system whose origin is the most forward point on the centreline of the VUT corresponding to the point (x4, y4).



1.2.3.4 Name of test object 2

Name TOB 2	Description
GVT	: Global Vehicle Target
RVT	: Real Vehicle Target
EPTa	: Euro NCAP Pedestrian Target adult
EPTc	: Euro NCAP Pedestrian Target child
EBTa	: Euro NCAP Bicyclist Target adult
EMT	: Euro NCAP Motorcyclist Target
RMT	: Real Motorcyclist Target
NOVALUE	: Not applicable

2 CHANNEL NAMES AND FILTERS

For test objects used in the different Euro NCAP tests, both physical and virtual, the following channel names shall be used. All channels shall be supplied either unfiltered or prefiltered. The appropriate filters of these channels will be performed by the analysis software used.

2.1 Vehicle for Active Safety tests

Location	Parameter	ISO code	Unit	RefSys	Assessment Calculation
Time (LSS & AEB)	Time series for FCW activation	10TFCW000000EV00	1	-	FCW Time-to-Collision
	Time series for LDW activation	10TLDW000000EV00	1	-	Distance to Line Crossing for LDW
	Time series where VUT enters in curve segment	10TECS000000EV00	1	-	T_{steer}
Time (Dooring)	Time series where VUT driver door opening interface	10TDOP000000EV00	1	-	Contact sensor / door operation channel / video [optional]
	Time series of Visual Information signal	10TINF000000EV00	1	-	
	Time series of Warning signal	10TWRN000000EV00	1	-	
	Time series when the door opens	10TDOP010000EV00	1	-	Contact sensor / door operation channel / video [optional]
Vehicle Front	Position X_{VUT}, Y_{VUT}	10VEHC000000DS[X,Y]P	m	TST	
	Speed V_{VUT_x}, V_{VUT_y}	10VEHC000000VE[X,Y]P	m/s	1DY	Relative impact speed, Speed reduction

	Acceleration A_{VUT_x}, A_{VUT_y}	10VEHC000000AC[X,Y]P	m/s²	1DY	
	Yaw velocity $\dot{\psi}_{VUT}$	10VEHC000000AVZP	rad/s	1DY	
	Yaw angle ψ_{VUT}	10VEHC000000ANZP	rad	TST	
Vehicle front wheel (outer edge)	Position $X_{VUT_{wheel}}$, $Y_{VUT_{wheel}}$	1[1,3]WHEL000000DS[X,Y]P	m	TST**	DTLE for LKA DTLE for LDW
Steering wheel	Steering wheel angle velocity	10STWL000000AV1P	rad/s	LOC	
	Steering wheel angle	10STWL000000AN1P	rad	LOC	
	Steering wheel torque	10STWL000000MO1P	Nm	LOC	Estimated torque from steering wheel
Accelerator pedal	Pedal position (robot output)	10PEAC000000DS0P	m	LOC	
Brake pedal	Pedal position (robot output)	10PEBR000000DS0P	m	LOC	
	Pedal Force	10PEBR000000FO0P	N	LOC	
Turning Indicator	Turning indicator	10TURN000000EV00	1	-	

***Origin on the lane marking (before the bend)*

2.2 Euro NCAP Global Vehicle Target

Location	Parameter	ISO code	Unit	RefSys	Assessment Calculation
GVT	Position X_{GVT}, Y_{GVT}	20VEHC000000DS[X,Y]P	m	TST	
	Speed V_{GVT_x}, V_{GVT_y}	20VEHC000000VE[X,Y]P	m/s	2DY	Relative impact speed
	Acceleration A_{GVT_x}	20VEHC000000ACXP	m/s^2	2DY	
	Yaw velocity $\dot{\psi}_{GVT}$	20VEHC000000AVZP	rad/s	2DY	
	Yaw angle ψ_{GVT}	20VEHC000000ANZP	rad	TST	

2.3 Euro NCAP Pedestrian Target

Location	Parameter	ISO code	Unit	RefSys	Assessment Calculation
EPT adult & child	Position X_{EPT}, Y_{EPT}	20PED[A,C]000000DS[X,Y]P	m	TST	
	Speed V_{EPT_x}, V_{EPT_y}	20PED[A,C]000000VE[X,Y]P	m/s	2DY	
	Acceleration A_{EPT_x}	20PED[A,C]000000ACXP	m/s^2	2DY	
	Yaw angle ψ_{EPT}	20PED[A,C]000000ANZP	rad	TST	
	Yaw velocity $\dot{\psi}_{EPT}$	20PED[A,C]000000AVZP	rad/s	2DY	

2.4 Euro NCAP Bicyclist Target

Location	Parameter	ISO code	Unit	RefSys	Assessment Calculation
EBT adult	Position	20CYCL000000DS[X,Y]P	m	TST	

	X_{EBT}, Y_{EBT}				
	Speed V_{EBT_x}, V_{EBT_y}	20CYCL000000VE[X,Y]P	m/s	2DY	
	Acceleration A_{EBT_x}	20CYCL000000ACXP	m/s²	2DY	
	Yaw angle ψ_{EBT}	20CYCL000000ANZP	rad	TST	
	Yaw velocity $\dot{\psi}_{EBT}$	20CYCL000000AVZP	rad/s	2DY	

2.5 Euro NCAP Motorcycle Target

Location	Parameter	ISO code	Unit	RefSys	Assessment Calculation
EMT	Position X_{EMT}, Y_{EMT}	20TWMB000000DS[X,Y]P	m	TST	
	Speed V_{EMT_x}, V_{EMT_y}	20TWMB000000VE[X,Y]P	m/s	2DY	
	Acceleration A_{EMT_x}	20TWMB000000ACXP	m/s²	2DY	
	Yaw angle ψ_{EMT}	20TWMB000000ANZP	rad	TST	
	Yaw velocity $\dot{\psi}_{EMT}$	20TWMB000000AVZP	rad/s	2DY	

3 ASSESSMENT CRITERIA CALCULATION

This chapter describes the calculation for the parameters used for the assessment criteria used within Euro NCAP active safety tests, including the filters that are applied to each channel used in these calculations. The test laboratory shall supply Euro NCAP with the filtered channels outlined in chapter 2, and the calculation of parameters will be done by Euro NCAP as described in this chapter.

3.1 Autonomous Emergency Braking

3.1.1 Relative impact speed

The (relative) impact speed is calculated with the following formula:

$$V_{rel,impact} = V_{VUT}(t_{impact}) - V_{target}(t_{impact})$$

With:

V_{VUT}	Speed of VUT
V_{target}	Speed of target
t_{impact}	Time of impact

For $V_{rel,impact}$ calculation in CPNA, CPFA, CPNCO, CBNA, CBFA and CBNAO scenarios, the Target's velocity component to be used shall be the one aligned with VUT direction of travel.

3.1.2 Speed reduction

The speed reduction is calculated with the following formula:

$$V_{reduction} = V_{VUT}(t_0) - V_{VUT}(t_{impact})$$

With:

V_{VUT}	Speed of VUT
t_0	Time of start of test
t_{impact}	Time of impact

3.1.3 Time-to-Collision

Time-to-collision (TTC) is defined, at an instant t, as the time remaining before a collision would occur if the relative speed between the VUT and the Target remains constant:

$$TTC(t) = \frac{D_{VUT\_Target}(t)}{V_{VUT}(t) - V_{target}(t)}$$

With:

$D_{VUT\_Target}(t)$	Closest distance between the Target bounding box and the VUT profiled line (i.e., closest polygon-to-polygon longitudinal distance) at the instant t

$V_{VUT}(t)$ Speed of VUT at the instant t

$V_{target}(t)$ Speed of target at the instant t

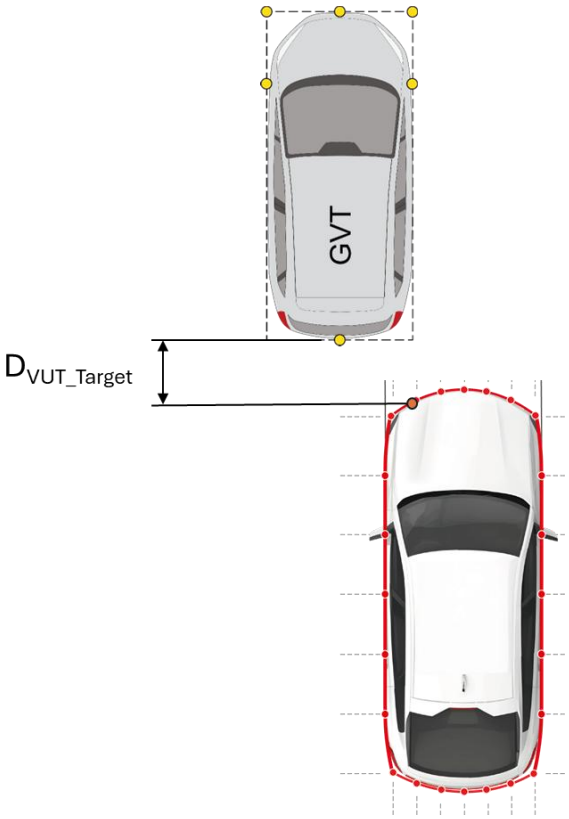


Figure 3-1 TTC in a CCRs scenario

3.1.4 Time Headway

Time Headway (THW) is defined, at an instant t, as the time it takes the VUT to travel the closest distance between the front of the VUT and the rear of the preceding Target.

$$THW(t) = \frac{D_{VUT_{Target}}(t)}{V_{VUT}(t)}$$

With:

$D_{VUT_{Target}}(t)$ closest distance between the Target bounding box and the VUT profiled line (i.e., closest polygon-to-polygon distance) at the instant t

$V_{VUT}(t)$ Speed of VUT at the instant t

3.1.5 FCW Time-to-Collision

The Time-to-Collision of FCW is calculated with the following formula:

$$TTC_{FCW} = TTC(t_{FCW})$$

With:

TTC	Time-to-Collision
t_{FCW}	Time of FCW initiation

3.2 Lane Support Systems

3.2.1 Distance to Line Crossing for LKA

The Distance-to-Line Crossing for LKA is calculated with the following formula:

$$DTLC_{LKA} = max(y_{VUT,wheel}) - y_{line}$$

With:

$y_{VUT,wheel}$	Lateral position of the outer edge of wheel
y_{line}	Lateral position coordinate of inner edge of line/road edge

3.2.2 Distance to Line Crossing for LDW

The Distance-to-Line Crossing for LDW is calculated with the following formula:

$$DTLC_{LDW} = y_{VUT,wheel}(t_{LDW}) - y_{line}$$

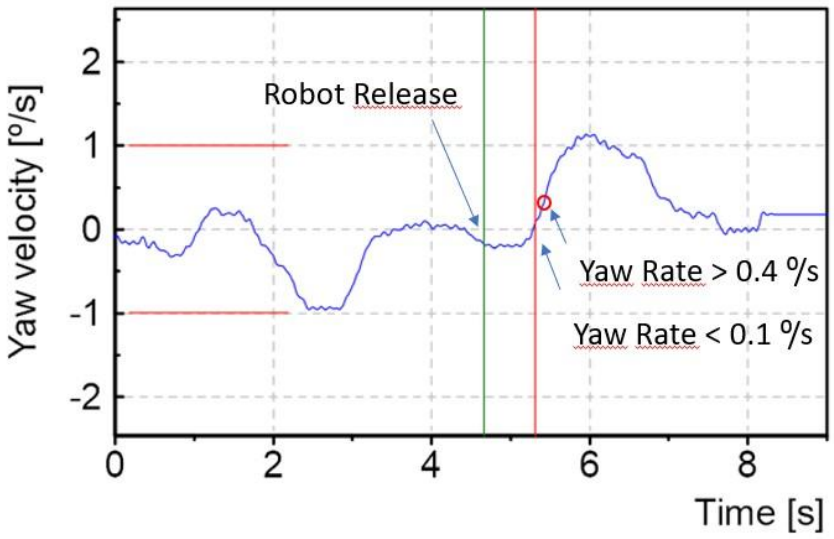
With:

$y_{VUT,wheel}$	Lateral position of the outer edge of wheel
t_{LDW}	Time of LDW initiation
y_{line}	Lateral position coordinate of inner edge of line/road edge

3.2.3 T_{LKA}

T_{LKA} means the time where the LKA system of the vehicle intervenes. Activation time is determined by the following sequence, based on Yaw velocity $\dot{\psi}_{VUT}$ during the LSS manoeuvre:

1. Steering robot release is triggered by X position of VUT (green vertical line)
2. Identify when $\dot{\psi}_{VUT}$ > 0,4°/s
3. From point 2., start searching backwards until $\dot{\psi}_{VUT}$ < 0,1°/s → T_{LKA} (red vertical line)



3.3 Acceleration application

3.3.1 T_{ACCEL}

T_{ACC} means the time where the accelerator pedal input is applied in CPMFC scenario (Low Speed Collisions protocol), which is as soon as the accelerator pedal position (10PEAC000000DS0P) has reached 90% of the total position.