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EUROPEAN NEW CAR
ASSESSMENT PROGRAMME

Technical Bulletin

Data format and Injury Criteria Calculation

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TB 021

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Preface

Euro NCAP contracts a number of different test laboratories in Europe to perform the official Euro NCAP tests. This Technical Bulletin describes how the test data is to be acquired and supplied to Euro NCAP to ensure consistency throughout all laboratories.

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1 TEST DATA

A complete Euro NCAP assessment consists of many tests. To ensure consistency in the general folder structure, this chapter details the required folder structure. For each (sub)test where measurements are performed on dummies, vehicles or other test equipment, all test data needs to be provided in ISO-MME 1.6 format and needs to be fully compliant with the ISO/TS 13499 standard. It should be noted that some filenames are also prescribed in this document.

1.1 General folder structure

The following 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

Where Euro NCAP tests contain a number of sub-tests, the next paragraph details the folder structure, names of the sub-system test folders and where applicable the filenames.

On the highest level, the folder structure is as follows with on the right an example using the Volvo XC90 that is assumed to be tested in 2022 with a Euro NCAP internal number of 9999.

• **MAIN FOLDER NAME**	• **22-VOL-9999-Volvo XC90**
<Frontal MPDB test number>	22-VOL-9999-MP1
<Frontal FW test number>	22-VOL-9999-FW1
<Side MDB test number>	22-VOL-9999-MD1
<Side Pole test number>	22-VOL-9999-PO1
<Side Pole O2O test number>	22-VOL-9999-O2O1
Whiplash tests folder	22-VOL-9999-WHL
Child Occupant Protection folder	22-VOL-9999-COP
Pedestrian tests folder	22-VOL-9999-PP
AEB Pedestrian test folder	22-VOL-9999-AEBP
AEB Bicyclist test folder	22-VOL-9999-AEBB
AEB Motorcyclist test folder	22-VOL-9999-AEBM
AEB Car-to-Car tests folder	22-VOL-9999-AEBC
SAS tests folder	22-VOL-9999-SAS
LSS tests folder	22-VOL-9999-LSS
SBR test number	22-VOL-9999-SBR
DSM information	22-VOL-9999-DSM
General information	22-VOL-9999-GEN
Inspection – *Lab name*	22-VOL-9999-INS-*lab name*
• Euro NCAP Spreadsheet.xlsm	• 22-VOL-9999-Volvo XC90 Spreadsheet.xlsm

Note: The term PO1 shall be applied to pole test using one WorldSID. The term O2O shall be applied to pole test using two WorldSIDs.

1.1.1 *Inspection folder*

The Inspection test folder contains one sub-test folder and two files. The folder contains the outputs from the MPDB test compatibility assessment.

- **MAIN FOLDER NAME**
- …
- Inspection
  - Compatibility assessment
  - HPD Static measurement file .xlsx
  - HCz report .pdf
  - Side impact intrusion measurements MD/PO
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-INS
  - 22-VOL-9999-COM
  - 22-VOL-9999-HPD .xls
  - 22-VOL-9999-HCZ .pdf
  - 22-VOL-9999-INT . xls
- …

1.1.2 *Whiplash sub-test folders*

The Whiplash test folder contains 3 sub-test folders. Two contain the dynamic data from the two dynamic pulses tested; Medium and High. In addition, the static whiplash data is contained in a separate folder, which also contains the static measurement file. The whiplash test report and the summary data plot report will be filed in the main Whiplash folder.

- **MAIN FOLDER NAME**
- …
- Whiplash tests folder
  - <Whiplash Medium test number>
    - xCrash summary data plot report .pdf
  - <Whiplash High test number>
    - xCrash summary data plot report .pdf
  - <Whiplash Static test number>
    - Static measurement file .xlsx
    - Whiplash test report .pdf
  - <Whiplash Rear test number>
    - Static measurement file .xlsx
    - Rear whiplash test report .pdf
    - Photo
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-WHL
  - 22-VOL-9999-WM1
    - 22-VOL-9999-WM1 .pdf
  - 22-VOL-9999-WH1
    - 22-VOL-9999-WH1 .pdf
  - 22-VOL-9999-WHS
    - 22-VOL-9999-WHLStatic .xls
    - 22-VOL-9999-WHL .pdf
  - 22-VOL-9999-WHR
    - 22-VOL-9999-WHRStatic .xls
    - 22-VOL-9999-WHR .pdf
    - Photo
- …

1.1.3 *COP sub-test folders*

The COP test folder contains 3 sub-test folders. They contain pictures and documents from both vehicle based assessment and the CRS installation checks as well as the vehicle manual (COP section) and CRS vehicle lists. The COP test report will be filed in the main COP folder.

- **MAIN FOLDER NAME**
  - …
  - COP tests folder
    - CRS installation
    - Vehicle based assessment
    - Manual - CRS vehicle lists
    - COP test report .pdf
  - …

- **22-VOL-9999-Volvo XC90**
  - …
  - 22-VOL-9999-COP
    - CRS installation
    - Vehicle based assessment
    - Manual-CRS vehicle lists
    - 22-VOL-9999-COP .pdf
  - …

1.1.4 *Pedestrian sub-test folders*

The Pedestrian test folder contains 6 sub-test folders. The document, movie, photo, report and static folders containing general files from all tests including certification documents, test temperatures and grid/test point 3D measurements. The folder test data contains a folder for every tested point. For each of these pedestrian tests there will be a separate sub-test folder (e.g. A10-5 folder), which needs to contain the channel and picture folders and the MME-file.

The test numbers for each sub-test consists of the Euro NCAP test number followed by the GRID point label.

The test report and the summary data plot report should be in the main report folder where the summary data plot report should contain all plots of all tests combined in one file called (20-VOL-9999-PP.pdf).

- **MAIN FOLDER NAME**
- …
- Pedestrian tests folder
  - Document
  - Photo – grid and selected points
  - Report
    - Pedestrian test report .pdf
  - Static
  - Test data
    - <Adult Headform test number>
    - <Child Headform test number>
    - …
    - <Upper Legform test number>
    - …
    - <Legform test number>
      - Channel
      - Movie
      - Photo
      - Report
        - xCrash data plot report .pdf
        - MME-file
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-PP
  - Document
  - Photo
  - Report
    - 22-VOL-9999-PP .pdf
  - Static
  - Test data
    - 22-VOL-9999-PP-A10-5
    - 22-VOL-9999-PP-C3+1
    - …
    - 22-VOL-9999-PP-U+2
    - …
    - 22-VOL-9999-PP-L-4
      - Channel
      - Movie
      - Photo
      - Report
        - 22-VOL-9999-PP xCrash Summary .pdf
        - 22-VOL-9999-PP-L-4.mme
  - …

1.1.5 *AEB Pedestrian sub-test folders*

The number of sub-test folders in the AEB Pedestrian test folder is depending on the AEB Pedestrian performance of the vehicle under test. For each of the test combinations, there will be a separate sub-test folder. The AEB Pedestrian test report will be filed in the main AEB Pedestrian folder in .pdf format, and it must follow the requirements of ISO 17025:2005.

- **MAIN FOLDER NAME**
- …
- AEB Pedestrian tests folder
  - <AEB-P CPFA50 35km/h test number>
  - …
  - <AEB-P CPNCO50 30km/h test number>
  - …
  - <AEB-P CPLA50 45km/h night test number>
  - …
  - …
  - AEB Pedestrian test report
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-AEBP
  - CPFa50_35VUT-01
  - …
  - CPNcO50_30VUT-01
  - …
  - CPLa50n_45VUT-01
  - …
  - …
  - 22-VOL-9999-AEBP Test Report.pdf
- …

The test naming format for each sub-test has the following structure:

Scenario_Direction_TestSpeed-Run
e.g. CPTa50_Nv_10VUT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (e.g. longitudinal 'PL', crossing 'PN/PF', turning 'PT' …)
3. Pedestrian type:
   - a = adult
   - c = child
4. Impact location, i.e. 25, 50, 75.
5. Obscuration vehicle present (if applicable): 'O'.
6. Specific scenario information (if applicable) i.e.:
   - s = static target
   - n = night testing
   - E = entry (pre-requisite test)

Direction → Specifies VUT and Test Target direction in turning scenarios (if applicable), i.e.:

- Nv: VUT turning to nearside, Test Target crossing on versus direction
- Ne: VUT turning to nearside, Test Target crossing on equal direction
- Fv: VUT turning to farside, Test Target crossing on versus direction
- Fe: VUT turning to farside, Test Target crossing on equal direction

TestSpeed → Speed of VUT (e.g. 10VUT).

Run → Test run number.

For reference, some examples are listed below

Format	Remarks
CPFa50_35VUT-01	xxVUT = VUT Speed (km/h)
CPNcO50_30VUT-01	
CPLa25_50VUT-01	
CPLa25_50VUT-02	-02 = Test run number
CPLa50n_45VUT-01	n = night
CPNa25_50VUT-01	
CPNa25n_50VUT-02	
CPNa75nE_20VUT-01	n = night; E = entry (pre-requisite test)
CPNa75E_20VUT-01	E = entry (pre-requisite test)
CPRa50_4VUT-01	
CPRa50_8VUT-01	
CPRc50_8VUT-01	Rear Child [moving]
CPRa50s_4VUT-01	s = static
CPRc75s_4VUT_01	
CPTa50_Nv_10VUT-01	Nv = Nearside Turn, VRU in versus direction
CPTa50_Fv_15VUT-01	Fv = Farside Turn, VRU in versus direction
CPTa50_Ne_10VUT-01	Ne = Nearside Turn, VRU in equal direction
CPTa50_Fe_20VUT-01	Fe = Farside Turn, VRU in equal direction

1.1.6 *AEB Bicyclist sub-test folders*

The number of sub-test folders in the AEB Bicyclist test folder is depending on the AEB Bicyclist performance of the vehicle under test. For each of the test combinations, there will be a separate sub-test folder. The AEB Bicyclist test report will be filed in the main AEB Bicyclist folder in .pdf format, and it must follow the requirements of ISO 17025:2005.

- **MAIN FOLDER NAME**
- …
- AEB Bicyclist tests folder
  - <AEB-B CBNa50 30km/h test number>
  - …
  - <AEB-B CBNaO50 40km/h test number>
  - …
  - <AEB-B CBDaO INFO test number>
  - …
  - …
  - AEB Pedestrian test report
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-AEBB
  - CBNa50_30VUT-01
  - …
  - CBNaO50_40VUT-01
  - …
  - CBDaO_INFO-01
  - …
  - …
  - 22-VOL-9999-AEBB Test Report.pdf
- …

The test naming format for each sub-test has the following structure:

Scenario_Direction_TestSpeed-Run
e.g. CBNA50_Nv_10VUT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (e.g. longitudinal 'BLA', crossing 'BNA/BFA', turning 'BTA' …)
3. Impact location, i.e. 25, 50.
4. Obscuration vehicle present (if applicable): 'O'.

Direction → Specifies VUT and Test Target direction in turning scenarios (if applicable), i.e.:

- Nv: VUT turning to nearside, Test Target crossing on versus direction
- Ne: VUT turning to nearside, Test Target crossing on equal direction
- Fv: VUT turning to farside, Test Target crossing on versus direction
- Fe: VUT turning to farside, Test Target crossing on equal direction

TestSpeed → Speed of VUT (e.g. 10VUT).

Run → Test run number.

<u>The dooring scenario</u> (CBDA) reserves a special structure, as follows

Scenario_Event-Run

e.g. CBDAO_INFO-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (i.e. 'BDAO')

Event → Specifies the test event in the dooring scenario, i.e.:

- INFO: Contains the files to assess the information given by VUT when the EBT passes the VUT without opening the door
- WARN: Contains the files to assess the warning given by VUT when attempting to open the door
- RET: Contains the files to assess the door operation retention when attempting to open the door.

For reference, some examples are listed below

Format	Remarks
CBNa50_30VUT-01	
CBFa50_45VUT-01	
CBNaO50_40VUT-01	
CBLa25_60VUT-01	
CBLa50_50VUT-01	
CBTa50_Nv_10VUT-01	Nv = Nearside Turn, versus direction
CBTa50_Fv_15VUT-01	Fv = Farside Turn, versus direction
CBDaO_INFO-01	Information
CBDaO_WARN-02	Warning
CBDaO_RET-01	Retention

1.1.7 *AEB Motorcycle sub-test folders*

The number of sub-test folders in the AEB Motorcycle test folder is depending on the AEB Motorcycle performance of the vehicle under test. For each of the test combinations, there will be a separate sub-test folder. The AEB Motorcycle test report will be filed in the main AEB Motorcycle folder in .pdf format, and it must follow the requirements of ISO 17025:2005.

- **MAIN FOLDER NAME**
- …
- AEB Motorcycle tests folder
  - <AEB-M CMRs50 30km/h test number>
  - …
  - <AEB-M CMRb25 12m. -4m/s² test number>
  - …
  - <AEB-M ELK oncoming0.6m/s 72km/h test number>
  - …
  - <AEB-M CMFt 20km/h 55km/h test number>
  - …
  - …
  - AEB Motorcycle test report
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-AEBM
  - CMRs50_AEB_30VUT-01
  - …
  - CMRb25_FCW_12_4-01
  - …
  - ELK_ONC_06D_72EMT-01
  - …
  - CMFt_20VUT_55EMT-01
  - …
  - 22-VOL-9999-AEBM Test Report.pdf
- …

The test naming format for each sub-test has the following structure:

a) **<u>For CMR tests:</u>**

Scenario_ AEB/FCW_Braking_TestSpeed-Run

e.g.CMRs50_AEB_30VUT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (i.e. stationary 'MFs', braking 'MFb')
3. Impact location: 25, 50.

AEB/FCW → Specifies whether it is an AEB or FCW assessment

Braking → Specifies the headway and EMT deceleration (if applicable) e.g..:

- 12_4 = 12 m. headway, 4m/s² EMT deceleration
- 40_4 = 40m. headway, 4m/s² EMT deceleration

TestSpeed → Speed of VUT (if applicable) – e.g.:

- 30VUT = VUT speed 30km/h

Run → Test run number.

b) **<u>For CMoncoming and CMovertaking tests:</u>**

Scenario_ LatSpeed_TestSpeed-Run

e.g. ELK_ONC_06D_72EMT-01

Where:

Scenario → CMoncoming and CMovertaking scenarios reserve a special structure to differentiate them from AEB tests, as these are essentially LSS tests (but part of AEB VRU assessment protocol). In order:

1. Scenario type (i.e. ELK).
2. Underscore '_'
3. Oncoming / Overtaking Intentional / Unintentional
   - ONC = Oncoming
   - OVI = Overtaking intentional
   - OVU = Overtaking unintentional

LatSpeed → Specifies the VUT lateral speed and the heading direction i.e.:

- 06D = 0.6 m/s, driver side

TestSpeed → Speed of EMT – i.e.:

- 72EMT = EMT speed 72km/h

Run → Test run number.

c) **<u>For CMFtap tests:</u>**

Scenario_ TestSpeed-Run

e.g. CMFt_20VUT_72EMT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. (i.e. CMFt).

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (i.e. 'MFt')

TestSpeed → Speed of VUT and Speed of EMT, separated by underscore '_' – i.e.:

- 20VUT_72EMT = VUT speed 20km/h, EMT speed 72km/h

Run → Test run number.

For reference, some examples are listed below:

Format	**Remarks**
CMRs50_AEB_30VUT-01	AEB
CMRb25_FCW_12_4-01	FCW, 25% impact location, 12m distance, 4m/s² deceleration
CMRb25_AEB_40_4-01	AEB, 25% impact location, 40m distance, 4m/s² deceleration
CMFt_20VUT_55EMT-01	
ELK_ONC_06D_72EMT-02	06D = 0,6m/s lateral velocity to Driver Side _Oncoming
ELK_OVU_06D_72EMT-01	OVU = Overtaking unintentional
ELK_OVU_05D_80EMT-01	
ELK_OVI_06D_72EMT-01	OVI = Overtaking intentional
ELK_OVI_06D_80EMT-01	

1.1.8 *AEB Car-to-Car sub-test folders*

The number of sub-test folders in the AEB Car-to-Car test folder is depending on the AEB Car-to-Car performance of the vehicle under test. For each of the test combinations, there will be a separate sub-test folder. The AEB Car-to-Car test report will be filed in the main AEB Car-to-Car folder in .pdf format, and it must follow the requirements of ISO 17025:2005.

- **MAIN FOLDER NAME**
- …
- AEB Car-to-Car tests folder
  - <AEB-C CCRs 30km/h AEB test number>
  - …
  - <AEB-C CCRm 50km/h FCW test number>
  - …
  - < AEB-C CCRb 40km/h AEB test number >
  - …
  - <AEB-C CCFt 10km/h 20km/h test number>
  - …
  - AEB Car-to-car test report
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-AEBC
  - CCRs_AEB_30VUT_075-01
  - …
  - CCRm_FCW_50VUT_175-01
  - …
  - CCRb_AEB_40_6-01
  - …
  - CCFt_10VUT_20GVT-01
  - …
  - 22-VOL-9999-AEBC Test Report.pdf
- …

The test naming format for each sub-test has the following structure:

a) **<u>For CCR tests:</u>**

Scenario_ AEB/FCW_Braking_TestSpeed-Run

e.g.CCRs50_AEB_30VUT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type (i.e. stationary 'CRs', moving 'CRm' , braking 'CRb')
3. Overlap (VUT vs GVT), with the following structure:

Overlap	**-50%**	**-75%**	**100**	**+75%**	**+50%**
Reference	150	175	100	075	050

AEB/FCW → Specifies whether it is an AEB or FCW assessment

Braking → Specifies the headway and GVT deceleration (if applicable) e.g..:

- 40_6 = 40 m. headway, 6m/s² EMT deceleration
- 12_2 = 12m. headway, 2m/s² EMT deceleration

TestSpeed → Speed of VUT (if applicable) – e.g.:

- 30VUT = VUT speed 30km/h

Run → Test run number.

b) **For CCFtap, CCFhol, CCFhos and CCCscp tests:**

Scenario_ TestSpeed-Run

e.g.CCFt_10VUT_20GVT-01

Where:

Scenario → Scenario acronym, without spacing, hyphens or underscores. In order:

1. VUT type:
   - C = Car
   - V = Van
   - H = Heavy Vehicle / Truck
2. Scenario type – i.e.:
   - CFt = turn across path
   - CFhs = head-on, straight
   - CFhl = head-on, lane change
   - CC = straight crossing path

TestSpeed → Speed of VUT and GVT– i.e.:

- 10VUT = VUT speed 10km/h
- Underscore '_'
- 20GVT = GVT speed 20km/h

Run → Test run number.

For reference, some examples are listed below:

Format	Remarks
CCRs_AEB_30VUT_075-01	Overlap 075 = +75%
CCRm_FCW_50VUT_175-01	Overlap 175 = -75%
CCRb_AEB_40_6-01	40m headway, 6 m/s² deceleration
CCRb_FCW_12_2-01	12m headway, 2 m/s² deceleration
CCFt_10VUT_20GVT-01	
CCFt_20VUT_55GVT-01	
CCC_20VUT_30GVT-01	
CCC_0VUT_30GVT-01	0VUT = Start from Stop
CCFhs_80VUT_80GVT-01	hs = Straight Path GVT head on straight
CCFhl_80VUT_80GVT-01	hl = Lane Change GVT

1.1.9 *Lane Support Systems sub-test folders*

The number of sub-test folders in the Lane Support Systems test folder is depending on the LSS performance of the vehicle under test. For each of the test combinations, there will be a separate sub-test folder. The Lane Support Systems test report will be filed in the main Lane Support Systems folder in .pdf format, and it must follow the requirements of ISO 17025:2005.

The test numbers for each sub-test consists of the Lane Support Systems scenarios (ELK-REN, ELK-RED, ELK-RES, ELK-SL, ELK-ON, ELK-OV, LKA-SL, LKA-DL), the lateral velocity and finally followed by the letter indicating left or right.

- **MAIN FOLDER NAME**
- …
- Lane Support Systems tests folder
  - < LSS ELK-REN 0.3 right test number >
  - …
  - < LSS ELK-OV 0.3 left test number >
  - …
  - < LSS LKA-SL 0.1 left test number >
  - …
  - < LSS LKA-SL 0.6 left test number >
  - …
  - < LSS LKA-SL 1.0 right test number >
  - …
  - LSS test report.pdf
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-LSS
  - ELK-REN-03R
  - …
  - ELK-OV-03L
  - …
  - LKA-SL-01L
  - …
  - LKA-SL-06L
  - ...
  - LKA-SL-10R
  - …
  - 22-VOL-9999-AEBC Test Report.pdf
- …

The test naming format for each sub-test has the following structure:

a) **<u>For LKA and LDW tests:</u>**

Scenario_ LatSpeed_TestSpeed-Run
e.g. LKA_SSL_06D-01

Where:

Scenario → Scenario acronym. In order::

4. Scenario type (i.e. LKA or LDW).
5. Underscore '_'
6. Lane marking
   - SSL = Single solid line
   - SDL = Single dashed line

LatSpeed → Specifies the VUT lateral speed and the heading direction i.e.:

- 06D = 0.6 m/s, driver side
- 07P = 0.7 m/s, passenger side

Run → Test run number.

b) For ELK road edge tests:

Scenario_ LatSpeed_TestSpeed-Run
e.g. ELK_REN_03D-01

Where:

Scenario → Scenario acronym. In order::

1. Scenario type (i.e. ELK).
2. Underscore '_'
3. Road edge type
   - REN = Road edge, no line
   - REC = Road edge with centre line
   - RED = Road edge with centre line & dashed line
   - RES = Road edge with centre line & solid line

LatSpeed → Specifies the VUT lateral speed and the heading direction i.e.:

- 03D = 0.3 m/s, driver side
- 04P = 0.4 m/s, passenger side

Run → Test run number.

c) For ELK oncoming/overtaking tests:

Scenario_ LatSpeed_TestSpeed-Run
e.g. ELK_ONC_06D_72GVT -01

Where:

Scenario → Scenario acronym. In order::

1. Scenario type (i.e. ELK).
2. Underscore '_'
3. Oncoming / Overtaking
   - ONC = Oncoming
   - OVI = Overtaking intentional
   - OVU = Overtaking unintentional

LatSpeed → Specifies the VUT lateral speed and the heading direction i.e.:

- 06D = 0.6 m/s, driver side

TestSpeed → Speed of GVT– i.e.:

- 80GVT = GVT speed 20km/h
- NVT = Oncoming, no GVT

Run → Test run number.

For reference, some examples are listed below:

Format	Remarks
LKA_SSL_03D-01	Single solid line
LKA_SDL_05P-01	Single dashed line
LDW_SSL_07D-01	Single solid line
LDW_SDL_07P-01	Single dashed line
ELK_REN_03D-01	Road Edge NO line
ELK_REC_04P-01	Road Edge with Center Line
ELK_RED_03P-01	Road Edge with Center Line & Dashed Line
ELK_RES_02P-01	Road Edge with Center Line & Solid Line
ELK_ONC_06D_NVT-01	Oncoming no vehicle Target
ELK_ONC_06D_72GVT-01	Oncoming with GVT
ELK_OVU_06D_72GVT-01	Overtaking unintentional GVT@72kph
ELK_OVU_05D_80GVT-01	Overtaking unintentional GVT@80kph
ELK_OVI_06D_72GVT-01	Overtaking intentional GVT@72kph
ELK_OVI_06D_80GVT-01	Overtaking intentional GVT@80kph

1.1.10 *Speed Assist Systems sub-test folders*

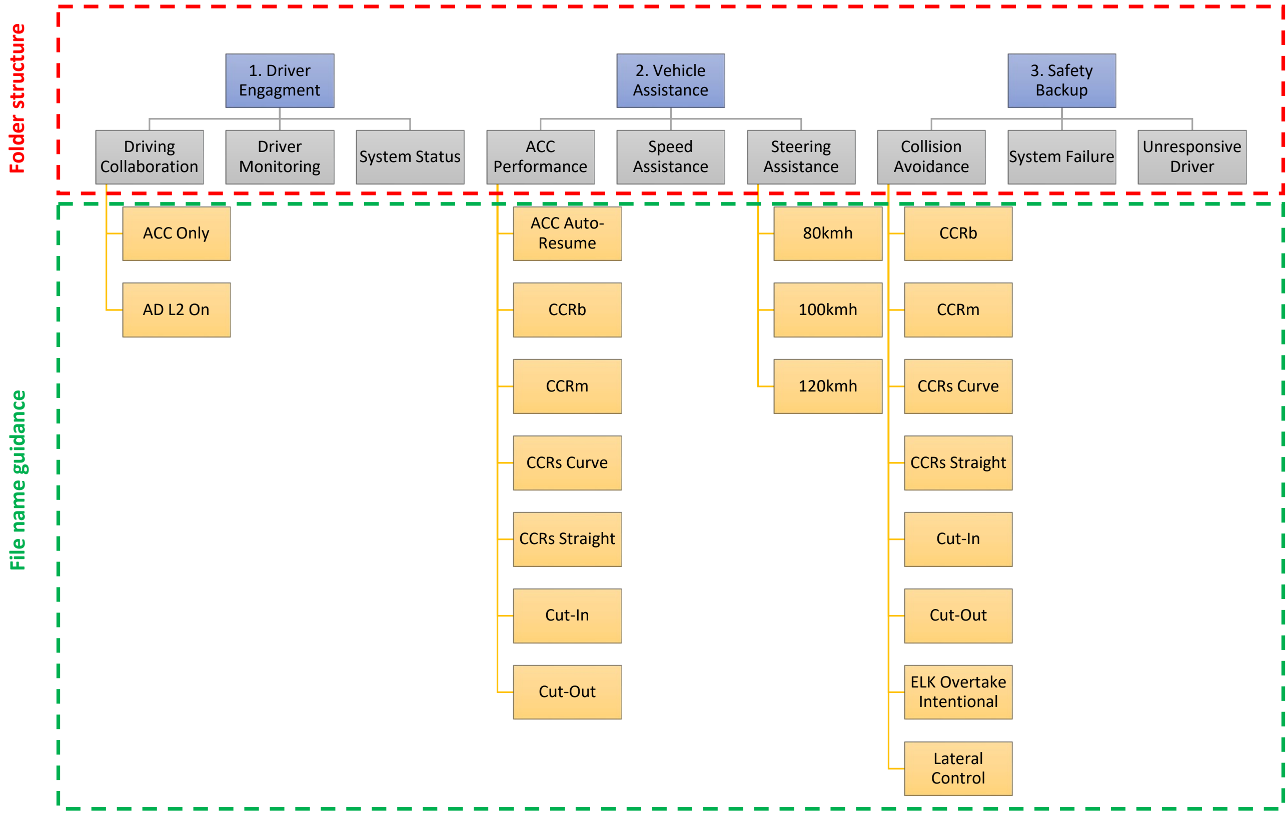
The Speed Assist Systems test folder contains 3 sub-test folders for the three speed limitation function tests. The Speed Assist Systems test report will be filed in the main Speed Assist Systems folder in .pdf format, and it must follow the requirements of ISO 17025:2005..

- **MAIN FOLDER NAME**
- …
- Speed Assist Systems tests folder
  - <Speed limitation 50km/h test number>
  - <Speed limitation 80km/h test number>
  - <Speed limitation 120km/h test number>
  - Speed Assist Systems test report .pdf
- …

- **22-VOL-9999-Volvo XC90**
- …
- 22-VOL-9999-SAS
  - SAS-50
  - SAS-80
  - SAS-120
  - 22-VOL-9999-SAS Test Report .pdf
- …

1.1.11 *Assisted Driving sub-test folders*

The Assisted Driving test folder contains 3 folders with 3 sub-folders each, according to the structure in below diagram:



The files must follow below naming convention:

ACC Performance and Collision Avoidance tests

Scenario	Test name	Example
CCRs - straight road	XXXX-AD_CCRs_Straight_<VUTSPEED>_<TARGETSPEED>_<OVERLAP>_<RUN>	0835-AD_CCRs_Straight_90VUT_00GVT_050-01
CCRs - curved road	XXXX-AD_CCRs_Curved_<VUTSPEED>_<TARGETSPEED>_<OVERLAP>_<RUN>	0835-AD_CCRs_Curved_90VUT_00GVT_150-01
CCRm - straight road	XXXX-AD_CCRm_<VUTSPEED>_<TARGETSPEED>_<OVERLAP>_<RUN>	0835-AD_CCRm_Straight_090VUT_20GVT_050-01
CCRb - straight road	XXXX-AD_CCRb_<TARGETDECEL>_<RUN>	0835-AD_CCRb_50VUT_50GVT_DECEL-4_Gap-Middle-01
Cut-in	XXXX-AD_CutIn_<VUTSPEED>_<TARGETSPEED>_<TTC>_<RUN>	0835-AD_CutIn_50VUT_10GVT1_1.5TTC_01
Cut-out	XXXX-AD_CutOut_<VUTSPEED>_<SOVSPEED>_<TARGETSPEED>_<TTC>_<RUN>	0835-AD_CutOut_90VUT_70GVT1_00GVT2_3TTC_01

ACC Auto-resume

Scenario	Test name	Example
Auto-resume test less hold time	XXXX-AD_ACC-Auto-resume-less	0835-AD_ACC-Auto-resume-less
Auto-resume test longer hold time	XXXX-AD_ACC-Auto-resume-longer	0835-AD_ACC-Auto-resume-longer
Auto-resume test external sensor	XXXX-AD_ACC-Auto-resume-surround	0835-AD_ACC-Auto-resume-surround
Auto-resume test driver monitoring sensor	XXXX-AD_ACC-Auto-resume-DM	0835-AD_ACC-Auto-resume-DM

Driver Monitoring

Scenario	Test name	Example
Driver monitoring ("hands-off / R79 test")	XXXX-AD_DM_<VUTSPEED>	0835-AD_DM_80

Driving Collaboration

Scenario	Test name	Example
Pothole test - system off	XXXX-AD_POT_<VUTSPEED>_SYSTEM-OFF-R_<RUN>	0835-AD_POT-72-SYSTEM-OFF_01
Pothole test - system on	XXXX-AD_POT_<VUTSPEED>_SYSTEM-ON-R_<RUN>	0835-AD_POT-72-SYSTEM-ON_01

Steering Assistance

Scenario	Test name	Example
Steering assistance - LSS OFF	XXXX-AD_SAC-LSS-OFF_<VUTSPEED>	0835-AD_SAC-LSS-OFF_80
Steering assistance - LSS ON	XXXX-AD_SAC-LSS-ON_<VUTSPEED>	0835-AD_SAC-LSS-ON_120

System Failure

Scenario	Test name	Example
Camera blocked at start-up	XXXX-AD_SF_Camera-blocked-at-Start-up	0835-AD_SF_Camera-blocked-at-Start-up
Camera blocked in Motion System Inactive	XXXX-AD_SF_Camera-blocked-in-Motion-System-inactive	0835-AD_SF_Camera-blocked-in-Motion-System-inactive
Camera blocked in Motion System Active	XXXX-AD_SF_Camera-blocked-in-Motion-System-active	0835-AD_SF_Camera-blocked-in-Motion-System-active
Radar blocked at start-up	XXXX-AD_SF_Radar-blocked-at-Start-up	0835-AD_SF_Radar-blocked-at-Start-up
Radar blocked in Motion System Inactive	XXXX-AD_SF_Radar-blocked-in-Motion-System-inactive	0835-AD_SF_Radar-blocked-in-Motion-System-inactive
Radar blocked in Motion System Active	XXXX-AD_SF_Radar-blocked-in-Motion-System-active	0835-AD_SF_Radar-blocked-in-Motion-System-active

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 six folders and two files. The following folders and files (comment files when needed) 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 NUMBER**
  - Channel
  - Document
  - Movie
  - Photo
  - Report
  - Static
  - <test number>.mme
  - <test number>.txt

1.2.1 *Channel folder*

The channel folder contains all channels from the vehicle, impactors and dummies used in the test as defined in section 2.

- **TEST NUMBER**
  - Channel
    - <test number>.xxx
    - <test number>.chn
  - …

1.2.2 *Document folder*

The document folder contains the calibration documents and temperature log files for the test dummies used in the test.

- **TEST NUMBER**
  - …
  - Document
    - < test number _ name of document file 1>
    - < test number _ name of document file d>
  - …

1.2.3 *Movie folder*

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

- **TEST NUMBER**
  - …
  - Movie
    - < test number _ name of movie file 1>
    - < test number _ name of movie file m>
  - …

1.2.4 *Photo folder*

The photo folder contains the inspection quality photos in two folders “Before” and “After”, where the name of the photo file consists of the test number followed by a number as specified in the Euro NCAP Film and Photo protocol.

- **TEST NUMBER**
  - …
  - Photo
    - Before
    - < test number _ name of photo file 1>
    - < test number _ name of photo file p>
    - After
    - < test number _ name of photo file 1>
    - < test number _ name of photo file p>
  - …

1.2.5 *Report folder*

The report folder contains the test report and the data plots.

- **TEST NUMBER**
  - …
  - Report
    - < test number _ name of test report>
    - < test number _ name of data plots>
  - …

1.2.6 *Static folder*

The static folder contains the static measurements file where applicable containing the data as described in the different test protocols. In the MPDB test, this folder shall also contain the data required for the compatibility assessment and details of barrier reconstruction where applicable. Please note, the raw data file of the MPDB face scan is not required.

- **TEST NUMBER**
  - …
  - Static
    - < test number _ name of static measurement file>
  - …

1.2.7 *MME-file*

The mme-file contains the information of the test where the type of test and subtype of test shall be selected from the table below.

- **TEST NUMBER**
  - …
  - <test number>.mme

The mme-file shall contain at least the following header:

Item	Header	Remarks
Data format edition number	:1.6	
Laboratory name	:<lab name>	
Customer name	:Euro NCAP	
Customer test ref. number	:<test number>	Full file name (Reference-Extension-Run)
Customer project ref. number	:<test series number>	4 digits number
Title	:Euro NCAP <year of test>	
Timestamp	:<date> <time>	
Type of the test	:<see table>	
Subtype of the test	:<see table>	
Regulation	:<test protocol version>	
Date of the test	:<date>	
Name of test object 1	:<make and model>	
Ref. number of test object 1	:<VIN number>	
Velocity test object 1 (longitudinal)	:<VUT longitudinal velocity>	Desired (scenario) velocity
Velocity test object 1 (Lateral)	:<VUT lateral velocity>	Desired (scenario) velocity
Mass test object 1	:<VUT mass>	
Driver position object 1	:<1/3>	LHD=1, RHD=3
Dimensions test object 1	:<length>, <width>	Dimensions as defined in protocol

Profile-X test object 1	:X1, X2, X3, X4, X5, X6	
Profile-Y test object 1	:Y1, Y2, Y3, Y4, Y5, Y6	
Name of test object 2	:<MPDB/GVT/PEDa/PEDc/EBT/EMT/…>	
Velocity test object 2	:<target velocity>	Desired (scenario) velocity

The type and subtype of tests is summarised below:

Euro NCAP test	**Type of Test**	**Subtype of test**
Frontal MPDB	Frontal Impact	MPDB
Frontal FW	Frontal Impact	FW
Side MDB	Side Impact	AE-MDB
Side Pole	Side Impact	Pole 75 degree
Side O2O	Side Impact	Pole 75 degree O2O
Whiplash	Rear Sled Test	Whiplash-Medium
		Whiplash-High
Pedestrian	Pedestrian	Adult / Child Headform
		Upper Legform / Legform
AEB Pedestrian	AEB	CPFA-50
		CPNA-25 / CPNA-75 (day or night)
		CPNCO-50
		CPLA-25 / CPLA-50 (day or night)
		CPTA
		CPRAm-50 / CPRCm-50
		CPRAs / CPRCs
AEB Bicyclist	AEB	CBDA
		CBFA
		CBNA-50 / CBNAO-50
		CBLA-25 / CBLA-50
		CBTA-50
AEB Power Two Wheeler	AEB	CMRs
		CMRb
		CMFtap
		CMoncoming
		CMovertaking
AEB Car-to-Car	AEB ESS FCW	CCRs
		CCRm
		CCRb
		CCFtap
		CCCscp
		CCFhos
		CCFhol
Lane Support Systems	LSS	ELK
		LKA
		LDW
		BSM

1.2.8 *Txt file*

The text file contains details of any test artefacts, errors or warnings associated with the test and how they should be considered.

- **TEST NUMBER**
  - …
  - <test number>.txt

2 CHANNEL NAMES AND FILTERS

For each dummy, impactors and test objects used in the different Euro NCAP tests the following channel names shall be used. All channels shall be supplied unfiltered/prefiltered. The appropriate filters for calculation of injury criteria and plotting of these channels will be performed by the analysis software used.

2.1 Hybrid III 50% Male

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	??HEAD0000H3AC[X,Y,Z]P	1000	Peak Resultant acceleration HIC_{15} Resultant 3ms cumulative exceedence
Neck	Forces, F_x F_y F_z	??NECKUP00H3FO[X,Y,Z]P	1000	Tension ($+F_z$) continuous exceedence Shear ($+F_x$ & $-F_x$) continuous exceedence Peak Extension (M_y)
	Moments, M_x M_y M_z	??NECKUP00H3MO[X,Y,Z]P	600	
Chest	Accelerations, A_x A_y A_z	??CHST0000H3AC[X,Y,Z]P	180	Peak resultant acceleration Resultant 3ms cumulative exceedence Peak deflection Viscous Criterion
	Deflection, D_{chest}	??CHST0003H3DSXP	180	
Pelvis	Accelerations, A_x A_y A_z	??PELV0000H3AC[X,Y,Z]P	600	
Lumbar Spine	Forces, F_x F_z	??LUSP0000H3FO[X,Z]P	600	
	Moments, M_y	??LUSP0000H3MOYP	600	
Femurs (L & R)	Forces, F_z	??FEMR[LE,RI]00H3FOZP	600	Compressive Axial Force ($-F_z$) continuous exceedence
Knees (L & R)	Displacements, D_{knee}	??KNSL[LE,RI]00H3DSXP	180	Peak displacement (-D)
Upper Tibia (L & R)	Forces, F_x F_z	??TIBI[LE,RI]UPH3FO[X,Z]P	600	Peak Tibia Compression ($-F_z$) Tibia Index
	Moments, M_x M_y	??TIBI[LE,RI]UPH3MO[X,Y]P	600	
Lower Tibia (L & R)	Forces, F_x F_z (F_y)	??TIBI[LE,RI]LOH3FO[X,Y,Z]P	600	Peak Tibia Compression ($-F_z$) Tibia Index
	Moments, M_x M_y	??TIBI[LE,RI]LOH3MO[X,Y]P	600	

2.2 THOR 50% Male

Location	Parameter		ISO code	CFC	Injury calculation
Head	Acceleration, A_x A_y A_z		??HEAD0000T3AC[X,Y,Z]P	1000	Peak Resultant acceleration HIC_{15} Resultant 3ms
	Angular rate sensor		??HEAD0000T3AV[X,Y,Z]P		
	Tilt sensor, X Y		??HEADPR00T3AN[X,Y]P		
Neck Cable	Force, Z		??NECK[FR,RE]00T3FOZP	1000	
Upper Neck	Force	F_x F_y F_z	??NECKUP00T3FO[X,Y,Z]P	1000	Tension ($+F_z$) Shear ($+F_x$ & $-F_x$) Peak Extension (M_y)
	Moment, M_x M_y M_z		??NECKUP00T3MO[X,Y,Z]P	600	
T1	Acceleration, A_x A_y A_z		??THSP0100T3AC[X,Y,Z]P	600	Peak acceleration
T4	Acceleration, A_x A_y A_z		??THSP0400T3AC[X,Y,Z]P	600	Peak acceleration
Clavicle (L&R)	Inner & Outer Force, F_x F_z		??CLAVLE[IN,OU]T3FO[X,Z]P	600	Peak force
Thorax	Distance, DC0		??CHST[LE,RI][UP,LO]T3DC0P	180	Peak displacement Viscous criterion
	Angle, Y Z		??CHST[LE,RI][UP,LO]T3AN[Y,Z]P	180	
Mid Sternum	Acceleration, A_x		??STRN0000T3ACXP	600	Peak acceleration
Abdomen	Distance, DC0		??ABDO[LE,RI]00T3DC0P	180	Peak displacement Viscous criterion
	Angle, Y Z		??ABDO[LE,RI]00T3AN[Y,Z]P	180	
	Acceleration, A_x		??ABDO0000T3AC[X,Y,Z]P	600	Peak acceleration
T12	Acceleration, A_x A_y A_z		??THSP1200T3AC[X,Y,Z]P	180	Peak acceleration
	Force, F_x F_y F_z		??LUSP0000T3FO[X,Y,Z]P	600	Peak force
	Moment, M_x M_y		??LUSP0000T3MO[X,Y]P	600	Peak moment
Pelvis	Acceleration, A_x A_y A_z		??PELV0000T3AC[X,Y,Z]P	600	Peak acceleration
	Tilt sensor, X Y		??PELVPR00T3AN[X,Y]P	-	
ASIS (L & R)	Force, F_x,		??ILAC[LE,RI]00T3FOXP	600	
	Moment, M_y		??ILAC[LE,RI]00T3MOYP	600	
Acetabulum (L & R)	Force, F_x F_y F_z		??ACTB[LE,RI]00T3FO[X,Y,Z]P	600	Compressive Force
Femurs (L & R)	Force, F_x F_y F_z		??FEMR[LE,RI]00T3FO[X,Y,Z]P	600	Compressive Axial Force ($-F_z$)
	Moment, M_x M_y M_z		??FEMR[LE,RI]00T3MO[X,Y,Z]P		
Knees (L & R)	Displacement, D_{knee}		??KNSL[LE,RI]00T3DSXP	180	Peak displacement (-D)
Upper Tibia (L & R)	Force, F_x F_z		??TIBI[LE,RI]UPT3FO[X,Z]P	600	Peak Tibia Compression ($-F_z$) Tibia Index
	Moment, M_x M_y		??TIBI[LE,RI]UPT3MO[X,Y]P	600	
Lower Tibia (L & R)	Force, F_x F_z		??TIBI[LE,RI]LOT3FO[X,Y,Z]P	600	Peak Tibia Compression ($-F_z$) Tibia Index
	Moment, M_x M_y		??TIBI[LE,RI]LOT3MO[X,Y]P	600	

2.3 Hybrid III 5% Female

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	??HEAD0000HFAC[X,Y,Z]P	1000	Peak Resultant acceleration HIC_{15} Resultant 3ms cumulative exceedence
Neck	Forces, F_x F_y F_z	??NECKUP00HFFO[X,Y,Z]P	1000	Tension (+F_z) continuous exceedence Shear (+F_x & -F_x) continuous exceedence Peak Extension (M_y)
	Moments, M_x M_y M_z	??NECKUP00HFMO[X,Y,Z]P	600	
Chest	Accelerations, A_x A_y A_z	??CHST0000HFAC[X,Y,Z]P	180	Peak resultant acceleration Resultant 3 ms cumulative exceedence Peak deflection Viscous Criterion
	Deflection, D_{chest}	??CHST0003HFDSXP	180	
Pelvis	Accelerations, A_x A_y A_z	??PELV0000HFAC[X,Y,Z]P	600	
Iliac (L & R)	Forces, F_x	??ILAC[LE,RI]00HFFOXP	600	
	Moments, M_y	??ILAC[LE,RI]00HFMOYP	600	
Lumbar Spine	Forces, F_x F_z	??LUSP0000HFFO[X,Z]P	600	
	Moments, M_y	??LUSP0000HFMOYP	600	
Femurs (L & R)	Forces, F_z	??FEMR[LE,RI]00HFFOZP	600	Compressive Axial Force (-F_z) Continuous exceedence
Knees (L & R)	Displacements, D_{knee}	??KNSL[LE,RI]00HFDSXP	180	Peak displacement (-D)
Upper Tibia (L & R)	Forces, F_x F_z	??TIBI[LE,RI]UPHFFO[X,Z]P	600	Peak Tibia Compression (-F_z) Tibia Index
	Moments, M_x M_y	??TIBI[LE,RI]UPHFMO[X,Y,Z]P	600	
Lower Tibia (L & R)	Forces, F_x F_z (F_y)	??TIBI[LE,RI]LOHFFO[X,Y,Z]P	600	Peak Tibia Compression (-F_z) Tibia Index
	Moments, M_x M_y	??TIBI[LE,RI]LOHFMO[X,Y,Z]P	600	

2.4 WorldSID 50% Male

Location	**Parameter**		**CFC**	**Injury Calculation**
Head	Accelerations, A_x A_y A_z	??HEAD0000WSAC[X,Y,Z]P	1000	HIC_{15} Peak acceleration 3ms exceedence (cumulative)
Upper Neck	Forces, F_x F_y F_z	??NECKUP00WSFO[X,Y,Z]P	1000	
	Moments, M_x M_y M_z	??NECKUP00WSMO[X,Y,Z]P	600	
Lower Neck	Forces, F_x F_y F_z	??NECKLO00WSFO[X,Y,Z]P	1000	
	Moments, M_x M_y M_z	??NECKLO00WSMO[X,Y,Z]P	600	
Shoulder	Forces, Fx, Fy, Fz	??SHLD[LE,RI]00WSFO[X,Y,Z]P	600	Peak lateral force
	Distance, R	??SHRI[LE,RI]00WSDC0P	180	Peak lateral displacement (Y) Viscous criterion
	Rotation, α	??SHRI[LE,RI]00WSANZP	180	
Thorax	Distance, R	??TRRI[LE,RI][01,02,03]WSDC0P	180	Peak lateral displacement (Y) Viscous criterion
	Rotation, α	??TRRI[LE,RI][01,02,03]WSANZP	180	
Abdomen	Distance, R	??ABRI[LE,RI][01,02]WSDC0P	180	Peak lateral displacement (Y) Viscous criterion
	Rotation, α	??ABRI[LE,RI][01,02]WSANZP	180	
T12	Accelerations, A_x A_y A_z	??THSP1200WSAC[X,Y,Z]P	180	
Lumbar Spine	Forces, F_x F_y F_z	??LUSP0000WSFO[X,Y,Z]P	600	
	Moments, M_x M_y M_z	??LUSP0000WSMO[X,Y,Z]P	600	
Pelvis	Accelerations, A_x A_y A_z	??PELV0000WSAC[X,Y,Z]P	600	Pubic Symphysis Force
	Forces, F_y	??PUBC0000WSFOYP	600	
Femoral Neck	Forces, F_x F_y F_z	??FEAC[LE,RI]00WSFO[X,Y,Z]P	600	

2.5 BioRID UN

Location	Parameter		CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	??HEAD0000BRAC[X,Y,Z]P	60	NIC
	Velocity, V_x	??HEAD0000BRVEXV		Head rebound velocity
	Contact	??HERE000000EV00		Head contact time
Cervical Spine	Accelerations, A_x A_z	??CESP0400BRAC[X,Z]P	60	
Neck Upper	Forces, F_x F_y F_z	??NECKUP00BRFO[X,Y,Z]P	1000	Nkm Neck shear (+F_x & -F_x) Neck tension (+Fz)
	Moments, M_x M_y M_z	??NECKUP00BRMO[X,Y,Z]P	600	Nkm
Neck Lower	Forces, F_x F_y F_z	??NECKLO00BRFO[X,Y,Z]P	1000	
	Moments, M_x M_y M_z	??NECKLO00BRMO[X,Y,Z]P	600	
Thoracic Spine T1 (L & R)	Accelerations, A_x A_z	??THSP01[LE,RI]BRAC[X,Z]P	60	T1- X-acceleration (avg) NIC
Thoracic Spine T8	Accelerations, A_x A_z	??THSP0800BRAC[X,Z]P	60	
Lumbar Spine	Accelerations, A_x A_z	??LUSP0100BRAC[X,Z]P	60	
Pelvis	Accelerations, A_x A_y A_z	??PELV0000BRAC[X,Y,Z]P	60	

2.6 Q6

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	??HEAD0000Q6AC[X,Y,Z]P	1000	HIC_{15} Resultant 3ms exceedence (cumulative)
Neck Upper	Forces, F_x F_y F_z	??NECKUP00Q6FO[X,Y,Z]P	1000	Peak Tensile Force F_z Resultant Force (side)
	Moments, M_x M_y M_z	??NECKUP00Q6MO[X,Y,Z]P	600	
Thorax	Accelerations, A_x A_y A_z	??THSP0000Q6AC[X,Y,Z]P	180	Resultant 3ms exceedence (cumulative)
	Displacement, D	??CHST0000Q6DSXP	180	Peak deflection

2.7 Q10

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	??HEAD0000QBAC[X,Y,Z]P	1000	HIC_{15} Resultant 3ms exceedence (cumulative)
Neck Upper	Forces, F_x F_y F_z	??NECKUP00QBFO[X,Y,Z]P	1000	Peak Tensile Force F_z Resultant Force (side)
	Moments, M_x M_y M_z	??NECKUP00QBMO[X,Y,Z]P	600	
Shoulder (side only)	Forces, F_x F_y F_z	??SHLD[LE,RI]00QBFO[X,Y,Z]P	1000	
T1 (side only)	Accelerations, A_y	??THSP01[LE,RI]QBACYP	1000	
Chest (T4)	Accelerations, A_x A_y A_z	??THSP0400QBAC[X,Y,Z]P	180	Resultant 3ms exceedence (cumulative)
Chest (frontal only)	Distance, R	??CHST[LO,UP]00QBDC0P	180	Peak deflection
	Rotation, α	??CHST[LO,UP]00QBANZP	180	
Chest (side only)	Distance, R	??CHST[LE,RI][LO,UP]QBDC0P	180	
	Rotation, α	??CHST[LE,RI][LO,UP]QBANZP	180	
Lumbar Spine	Forces, F_x F_y F_z	??LUSP0000QBFO[X,Y,Z]P	1000	
	Moments, M_x M_y M_z	??LUSP0000QBMO[X,Y,Z]P	600	
Pelvis-Sacrum	Accelerations, A_x A_y A_z	??PELV0000QBAC[X,Y,Z]P	180	
Pelvis-Pubis (side only)	Forces, F_y	??PUBC0000QBFOYP	1000	

2.8 Adult Headform

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	D0HEAD0000PJAC[X,Y,Z]P	1000	HIC_{15}

2.9 Small Adult / Child Headform

Location	Parameter	ISO code	CFC	Injury Calculation
Head	Accelerations, A_x A_y A_z	D0HEAD0000PSAC[X,Y,Z]P	1000	HIC_{15}

2.10 Upper Legform

Location	Parameter	ISO code	CFC	Injury Calculation
Femur	Forces, F_x	D0FEMR[UP,LO]00PUFOXP	180	Sum of Forces
	Moments, M_y	D0FEMR[UP,MI,LO]00PUMOYP	180	Bending Moment

2.11 Legform (aPLI)

Location	Parameter	ISO code	CFC	Injury Calculation
Upper Mass	Accelerations, A_x A_y A_z	??PELV0000PMAC[X,Y,Z]P		
Femur	Moments, M_x	??FEMR[UP,MI,LO]00PMMOXP		Bending Moment
Knee	Displacement, D_{MCL}	??KNEEMC00PMDS0P		MCL Elongation
	Displacement, D_{PCL}	??KNEEPC00PMDS0P		PCL Elongation
	Displacement, D_{ACL}	??KNEEAC00PMDS0P		ACL Elongation
Tibia	Moments, M_x	??TIBI[UP,LO]00PMMOXP ??TIBIMI[UP,LO]PMMOXP		Bending Moment

2.12 Vehicle for Passive Safety tests

Location	Parameter	ISO code	CFC	Injury Calculation
B-Pillar	Accelerations, A_x A_y	[14,16]BPILL00000AC[X,Y]P	60	
Seatbelt	Force, $F_{seatbelt}$	??SEBE0003B3FO0P	60	Seat belt force modifier
Vehicle trunk	Angular rate sensor	18TUNN000000AV[X,Y,Z]P	60	

2.13 Trolley

Location	Parameter	ISO code	CFC	Injury Calculation
CoG	Accelerations, A_x	M0MBARCG0000ACXP	60 180	 For velocity integration

2.14 Sled

Location	Parameter	ISO code	CFC	Injury Calculation
Sled	Accelerations, A_x	S0SLED000000ACXP	60	

2.15 Vehicle for Active Safety tests

Location	Parameter	ISO code	Unit	RefSys	CFC	Assessment Calculation
Time (AEB)	Time-to-Collision	10TTTC000000TI00	s	-		FCW Time-to-Collision
	AEB activation time	10TAEB000000EV00	1	-		
	FCW activation time	10TFCW000000EV00	1	-		FCW Time-to-Collision
	Impact time	10TIMPFR0000EV00	1	-		Relative impact speed, Speed reduction
	Time where VUT enters in curve segment	10TECS000000EV00	1	-		
Time (LSS)	LKA activation time	10TLKA000000EV00	1	-		
	LDW activation time	10TLDW000000EV00	1	-		Distance to Line Crossing for LDW
	Line crossing time	10TLCRFR[LE,RI]00EV00	1	-		
Time (Dooring)	Time where VUT driver door opening interface	T_door_operation 10TDOP000000EV00	1	-		Contact sensor / door operation channel / video [optional]
	Time when the door opens	T_open 10TDOP000000EV00	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}	10VEHC000000ACXS	m/s^2	1DY	*	
	Yaw velocity $\boldsymbol{\Psi}_{VUT}$	10VEHC000000AVZP	rad/s	1DY		
	Yaw angle	10VEHC000000ANZP	rad	TST		
	Lateral path error $Y_{VUT,error}$	10VEHC00DI00DCYP	m	LOC		
	Relative distance VUT – Target	10VEHC00DI00DS[X,Y]P	m	1DY		Impact / no impact and BSM (Define target reference point for each scenario)
Vehicle front wheel (outer edge)	Position XVUT,wheel, YVUT,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		
Accelerator pedal	Pedal position (robot output)	10PEAC000000DS0P	m	LOC		
Brake pedal	Pedal position (robot output)	10PEBR000000DS0P	m	LOC		
	Pedal Force	10PEBR000000FO0P	N	LOC		

**Driving dynamics filter, 10Hz, 12 pole butterworth, phase compensated*
***Origin on the lane marking (before the bend)*

2.16 Euro NCAP Vehicle Target

Location	Parameter	ISO code	Unit	RefSys	CFC	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_x	20VEHC000000ACXS	m/s^2	2DY	*	
	Yaw velocity Ψ_{GVT}	20VEHC000000AVZS	rad/s	2DY	*	
	Yaw angle	20VEHC000000ANZP	rad	TST		
	Lateral path error $Y_{GVT,error}$	20VEHC00DI00DCYP	m	LOC		

**Driving dynamics filter, 10Hz, 12 pole butterworth, phase compensated*

2.17 Euro NCAP Pedestrian Target

Location	Parameter	ISO code	Unit	RefSys	CFC	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_x	20PED[A,C]000000ACXS	m/s^2	2DY	*	
	Yaw angle	20PED[A,C]000000ANZS	rad/s	TST	*	
	Yaw velocity Ψ_{EPT}	20PED[A,C]000000AVZP	rad	2DY		
	Lateral path error $Y_{EPT,error}$	20PED[A,C]00DI00DCYP	m	LOC		

**Driving dynamics filter, 10Hz, 12 pole butterworth, phase compensated*
***Moving moving direction is always "X" according to ISO TF MME Active Safety*

2.18 Euro NCAP Byciclist Target

Location	Parameter	ISO code	Unit	RefSys	CFC	Assessment Calculation
EBT adult	Position X_{EBT} , Y_{EBT}	20CYCL000000DS[X,Y]P	m	TST		
	Speed $V_{EBT,x}$,$V_{EBT,y}$	20CYCL000000VE[X,Y]P	m/s	2DY		
	Acceleration A_x	20CYCL000000ACXS	m/s^2	2DY	*	
	Yaw angle	20CYCL000000ANZS	rad/s	TST	*	
	Yaw velocity $\boldsymbol{\Psi}_{EBT}$	20CYCL000000AVZP	rad	2DY		
	Lateral path error $Y_{EBT,error}$	20CYCL00DI00DCYP	m	LOC		

**Driving dynamics filter, 10Hz, 12 pole butterworth, phase compensated*

2.19 Euro NCAP Motorcycle Target

Location	Parameter	ISO code	Unit	RefSys	CFC	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_x	20TWMB000000ACXS	rad/s	2DY	*	
	Yaw angle	20TWMB000000ANZS	rad	TST	*	
	Yaw velocity $\boldsymbol{\Psi}_{EMT}$	20TWMB000000AVZP	m/s^2	2DY**		
	Lateral path error $Y_{EMT,error}$	20TWMB00DI00DCYP	m	LOC		

**Driving dynamics filter, 10Hz, 12 pole butterworth, phase compensated*
***Moving direction is always "X" according to ISO TF MME Active Safety*

3 INJURY CRITERIA CALCULATION

This chapter describes the calculation for each injury criterion used within Euro NCAP, including the filters that are applied to each channel used in these calculations. The analysis software used by the Euro NCAP labs will follow these calculations in detail.

Euro NCAP's calculation spreadsheet expects only positive values for the injury criteria used. Therefore, negative values such as chest compression, the criterion is calculated as the absolute value of the minimum.

For all of the calculations and for all of the dummies used, only the loading phase of the crash is considered. Usually, the loading phase for all dummies in the frontal tests will end at the point in time where the filtered head acceleration A_x crosses zero g after the minimum acceleration peak value. This does not apply to the farside occupant-to-occupant test, the loading phase to evaluate occupant-to-occupant interaction will end when all parts of both dummies are moving outboard.

It is up to the testing authority to confirm and determine the actual end of the loading phase.

3.1 Head criteria

3.1.1 Head Resultant Acceleration

The Head Resultant Acceleration is calculated with the following formula:

$$A_R = \sqrt{{A_x}^2 + {A_y}^2 + {A_z}^2}$$

with:

A_x	Filtered Head Acceleration A_x	??HEAD0000??ACXA
A_y	Filtered Head Acceleration A_y	??HEAD0000??ACYA
A_z	Filtered Head Acceleration A_z	??HEAD0000??ACZA

3.1.2 HIC_{15}

The HIC_{15} value is calculated with the following formula:

$$HIC_{15} = (t_2 - t_1)\left(\frac{1}{(t_2 - t_1)}\int_{t_1}^{t_2} A_R dt\right)^{2.5}$$

with:

A_R Head Resultant Acceleration

3.1.3 Diffuse Axonal Multi-Axis General Evaluation (DAMAGE)

The DAMAGE criterion is calculated in accordance with TB 035 and the following formula:

$$\begin{bmatrix} m_x & 0 & 0 \\ 0 & m_y & 0 \\ 0 & 0 & m_z \end{bmatrix} \begin{Bmatrix} \ddot{\delta}_x \\ \ddot{\delta}_y \\ \ddot{\delta}_z \end{Bmatrix} + \begin{bmatrix} c_{xx}+c_{xy}+c_{xz} & -c_{xy} & -c_{xz} \\ -c_{xy} & c_{xy}+c_{yy}+c_{yz} & -c_{yz} \\ -c_{xz} & -c_{yz} & c_{xz}+c_{yz}+c_{zz} \end{bmatrix} \begin{Bmatrix} \dot{\delta}_x \\ \dot{\delta}_y \\ \dot{\delta}_z \end{Bmatrix} +$$

$$\begin{bmatrix} k_{xx}+k_{xy}+k_{xz} & -k_{xy} & -k_{xz} \\ -k_{xy} & k_{xy}+k_{yy}+k_{yz} & -k_{yz} \\ -k_{xz} & -k_{yz} & k_{xz}+k_{yz}+k_{zz} \end{bmatrix} \begin{Bmatrix} \delta_x \\ \delta_y \\ \delta_z \end{Bmatrix} = \begin{bmatrix} m_x & 0 & 0 \\ 0 & m_y & 0 \\ 0 & 0 & m_z \end{bmatrix} \begin{Bmatrix} \ddot{u}_x \\ \ddot{u}_y \\ \ddot{u}_z \end{Bmatrix}$$

$$DAMAGE = \beta max_t\{|\vec{\delta}(t)|\}$$

$\vec{\delta}(t) = [\delta_x(t) \quad \delta_y(t) \quad \delta_z(t)]^T$, β = scale factor

m = mass, c_{ij} = damping, k_{ij} = stiffness

$\ddot{\delta}, \dot{\delta}, \delta = acceleration, velocity, displacement$

$\ddot{u} = applied\ angular\ acceleration$

$m_x = 1\ kg, m_y = 1\ kg, m_z = 1\ kg$

$k_{xx} = 32142\ N/m, k_{yy} = 23493\ N/m, k_{zz} = 16935\ N/m,$

$k_{xy} = 0\ N/m, k_{yz} = 0\ N/m, k_{xz} = 1636.3\ N/m, a1$=5.9148 ms, β=2.9903 $1/m$

$[c] = a1 \times [k]$

3.1.4 Head Restraint Contact Time

The Head Restraint Contact Time is calculated with the following formula:

$$T_{HRC} = T_{HRC,end} - T_{HRC,start}$$

with:

$T_{HRC,start}$	Time of first contact of head and HR after T=0	??HERE000000EV00
$T_{HRC,end}$	Time where contact is lost	??HERE000000EV00

Gaps up to 1ms are ignored if proven to be the result of poor electrical contact.

3.1.5 T1 x-acceleration

The T1 x-acceleration value is calculated with the following formula:

$$T1 = \frac{T1_{left} + T1_{right}}{2}$$

with:

$T1_{left}$	Filtered left T1 acceleration	??THSP01LEBRACXD
$T1_{right}$	Filtered right T1 acceleration	??THSP01RIBRACXD

3.2 Neck criteria

3.2.1 Neck extension bending moment @ OC

The Neck extension bending moment is calculated with the following formula:

$$M_{OCy} = M_y - F_x \cdot d$$

with:

M_y	Filtered Bending Moment	??NECKUP00??MOYB
F_x	Filtered Shear Force	??NECKUP00??FOXB
d	0.01778m for HIII-50M & HIII-05F and 0.0195m for WorldSID	

3.2.2 Neck lateral flexion bending moment @ OC

The Neck lateral flexion bending moment is calculated with the following formula:

$$M_{OCx} = M_x + F_y \cdot d$$

with:

M_x	Filtered Bending Moment	??NECKUP00WSMOXB
F_y	Filtered Shear Force	??NECKUP00WSFOYB
d	0.0195m WorldSID	

3.2.3 Neck extension bending moment

The Neck extension bending moment is calculated with the following formula:

$$M_y = abs\left(\min\left(M_y\right)\right)$$

with:

M_y	Filtered Bending Moment for THOR	??NECKUP00??MOYB
M_y	Filtered Bending Moment for WorldSID	??NECKLO00??MOYB

3.2.4 Neck lateral flexion bending moment @ Neck base

$$Mx_{(base\ of\ neck)} = \left|\min(Mx_M - Fy_M * Dz)\right|$$

with:

Mx_M =	Filtered Bending Moment	??NECKLO00WSMOXB
Fy_M =	Filtered Shear Force	??NECKLO00WSFOYB
Dz =	0.0145m for WorldSID (ISO 15830)	

$$My_{(base\ of\ neck)} = \left|\min(My_M + Fx_M * Dz)\right|$$

with:

My_M =	Filtered Bending Moment	??NECKLO00WSMOYB
Fx_M =	Filtered Shear Force	??NECKLO00WSFOXB
Dz =	0.0145m for WorldSID (ISO 15830)	

3.2.5 NIC

The NIC value is calculated with the following formula:

$$NIC = 0.2 \cdot A_{rel} + {v_{rel}}^2$$

with:

$$A_{rel} = T1 - A_{x,head}$$

$$v_{rel} = \int A_{rel}$$

T1	Average T1 acceleration	
$A_{x,head}$	Filtered Head Acceleration A_x	??HEAD0000BRACXD

3.2.6 Nkm

The Nkm value is calculated with the following formula:

$$Nkm(t) = N_{ep}(t) + N_{ea}(t) + N_{fp}(t) + N_{fa}(t)$$

with:

$$N_{ep}(t) = \frac{M_{ocye}(t)}{-47.5Nm} + \frac{F_{xp}(t)}{-845N}$$

$$N_{ea}(t) = \frac{M_{ocye}(t)}{-47.5Nm} + \frac{F_{xa}(t)}{845N}$$

$$N_{fp}(t) = \frac{M_{ocyf}(t)}{88.1Nm} + \frac{F_{xp}(t)}{-845N}$$

$$N_{fa}(t) = \frac{M_{ocyf}(t)}{88.1Nm} + \frac{F_{xa}(t)}{845N}$$

$$M_{OCy}(t) = M_y(t) - D \cdot F_x(t)$$

$F_x(t)$	Filtered Upper Neck Shear Force F_x	??NECKUP00BRFOXB
$M_y(t)$	Filtered Upper Neck Moment M_y	??NECKUP00BRMOYB
D	0.01778m	

$F_{xp}(t)$	negative portion of $F_x(t)$
$F_{xa}(t)$	positive portion of $F_x(t)$
$M_{ye}(t)$	negative portion of $M_{OCy}(t)$
$M_{yf}(t)$	positive portion of $M_{OCy}(t)$

3.3 Shoulder criteria

3.3.1 Lateral Shoulder Force

The Lateral Shoulder Force is calculated with the following formula:

$$Fy_{shoulder} = abs\left(\min\left(F_y(t)\right)\right)$$

with:

F_y	Filtered Shoulder Force F_y	??SHLD[LE,RI]00WSFOYB

3.3.2 Lateral Shoulder Rib Displacement

The Lateral Shoulder Rib Displacement is calculated with the following formula:

$$Dy_{shoulder} = \max\left(D_y(t) - D_y(0)\right)$$

with:

$D_y(t) = R(t) \cdot \sin(\Phi(t))$

R(t)	Filtered Shoulder sensor length	??SHRI[LE,RI]00WSDC0C
Φ(t)	Filtered Shoulder sensor rotation	??SHRI[LE,RI]00WSANZC
$D_y(0)$	Lateral Shoulder Rib Displacement @ t=0	

Further details regarding definitions for measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002.

3.4 Chest criteria

3.4.1 Chest Deflection

The Chest Deflection value is calculated with the following formula:

$$D_{chest} = \max\left(D_{chest}(t)\right)$$

with:

$D_{chest}(t)$	Filtered Chest Deflection D_{chest}	??CHST0003??DSXC

3.4.2 Chest Rib Displacement

The Chest Rib Displacement is calculated with the following formula:

$$D_{rib} = max\left(\sqrt{D_x(t)^2 + D_y(t)^2 + D_z(t)^2}\right)$$

with:

$$D_x(t) = \delta \cdot sin\left(\Phi_y(t)\right) + R(t) \cdot cos(\Phi_z(t)) \cdot cos\left(\Phi_y(t)\right) - D_x(0)$$

$$D_y(t) = R(t) \cdot sin(\Phi_z(t)) - D_y(0)$$

$$D_z(t) = \delta \cdot cos\left(\Phi_y(t)\right) - R(t) \cdot cos(\Phi_z(t)) \cdot sin\left(\Phi_y(t)\right) - D_y(0)$$

R(t)	Filtered Chest Rib sensor length	??CHST[LE,RI][UP,LO]T3DC0C
$\Phi_y(t)$	Filtered Chest Rib sensor rotation	??CHST[LE,RI][UP,LO]T3ANYC
$\Phi_z(t)$	Filtered Chest Rib sensor rotation	??CHST[LE,RI][UP,LO]T3ANZC
$D_{[x,y,z]}(0)$	Chest Rib Displacement in x,y,z direction @ t=0	

δ	+15.65mm for Upper Chest Rib and -15.65mm for Lower Chest Rib	

Definitions regarding measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002. Where a vehicle is equipped with pretensioners that activate before T0, the displacement prior to activation shall be used for $D_{x,y,z}(0)$.

3.4.3 Chest Displacement

The Chest Displacement in the MPDB test is calculated for the upper and lower measurement system with the following formula:

$$D_x = \max(D_x(t) - D_x(0))$$

with:

$$D_x(t) = R(t) \cdot cos(\Phi_z(t))$$

R(t)	Filtered sensor length	??CHST[LO,UP]00QBDC0C
$\Phi_z(t)$	Filtered sensor rotation	??CHST[LO,UP]00QBANZC
$D_x(0)$	Chest Displacement @ t=0	

Definitions regarding measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002. Where a vehicle is equipped with pretensioners that activate before T0, the displacement prior to activation shall be used for $D_x(0)$.

3.4.4 Seatbelt force modifier

The Seatbelt force modifier is calculated with the following formula:

$$F_{seatbelt} = \max\,(F_{seatbelt}(t))$$

with:

$F_{seatbelt}$	Filtered Seatbelt Force	??SEBE0003B3FO0D

3.4.5 Lateral Thoracic Rib Displacement

The Lateral Thoracic Rib Displacement is calculated with the following formula:

$$Dy_{thorax} = \max\left(D_y(t) - D_y(0)\right)$$

with:

$$D_y(t) = R(t) \cdot \sin(\Phi(t))$$

R(t)	Filtered Thoracic sensor length	??TRRI[LE,RI]01??DC0C
Φ (t)	Filtered Thoracic sensor rotation	??TRRI[LE,RI]01??ANZC
$D_y(0)$	Lateral Thoracic Rib Displacement @ t=0	

Definitions regarding measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002.

3.4.6 Viscous Criterion

The VC is calculated with the following formula:

$$VC = sf \cdot V(t) \times C(t)$$

With:

sf	1.3 for HIII-50M, 1.3 for HIII-05F and 1.0 for WorldSID	

$$V(t) = \frac{8(D_{chest}(t+1) - D_{chest}(t-1)) - (D_{chest}(t+2) - D_{chest}(t-2))}{12\Delta t}$$

$$C(t) = \frac{D_{chest}(t)}{D_{constant}}$$

$D_{chest}(t)$	Filtered Chest Deflection D_{chest} for WorldSID use calculated Lateral Thoracic Rib Displacement Dy_{thorax}	??CHST0003??DSXC
Δt	Time step	
$D_{constant}$	0.229 for HIII-50M, 0.187 for HIII-05F and 0.170 for WorldSID	

3.5 Abdomen criteria

3.5.1 T12 Resultant Acceleration

The T12 Resultant Acceleration is calculated with the following formula:

$$A_R = \sqrt{{A_x}^2 + {A_y}^2 + {A_z}^2}$$

with:

A_x	Filtered T12 Acceleration A_x	??THSP1200WSACXC
A_y	Filtered T12 Acceleration A_y	??THSP1200WSACYC
A_z	Filtered T12 Acceleration A_z	??THSP1200WSACZC

3.5.2 Abdominal Rib Displacement (THOR)

The Abdominal Rib Displacement is calculated with the following formula:

$$D_{rib} = max(D_x(t))$$

with:

$$D_x(t) = R(t) \cdot cos(\Phi_z(t)) \cdot cos\big(\Phi_y(t)\big) - D_x(0)$$

R(t)	Filtered Abdominal Rib sensor length	??ABDO[LE,RI]00T3DC0C
$\Phi_y(t)$	Filtered Abdominal Rib sensor rotation	??ABDO[LE,RI]00T3ANYC
$\Phi_z(t)$	Filtered Abdominal Rib sensor rotation	??ABDO[LE,RI]00T3ANZC
$D_{[x,y,z]}(0)$	Abdominal Rib Displacement in x,y,z direction @ t=0	

Definitions regarding measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002. Where a vehicle is equipped with pretensioners that activate before T0, the displacement prior to activation shall be used for $D_{x,y,z}(0)$.

3.5.3 Lateral Abdominal Rib Displacement

The Lateral Abdominal Rib Displacement is calculated with the following formula:

$$Dy_{abdomen} = \max\left(D_y(t) - D_y(0)\right)$$

with:

$$D_y(t) = R(t) \cdot \sin(\Phi(t))$$

R(t)	Filtered Abdominal sensor length	??ABRI[LE,RI]01WSDC0C
Φ(t)	Filtered Abdominal sensor rotation	??ABRI[LE,RI]01WSANZC
$D_y(0)$	Lateral Abdominal Rib Displacement @ t=0	

Definitions regarding measurement coordinate system, sensor offsets and polarities, and post-processing can be found in ISO/TS21002.

3.5.4 Viscous Criterion

The VC is calculated with the following formula:

$$VC = sf \cdot V(t) \times C(t)$$

With:

sf 1.0 for WorldSID

$$V(t) = \frac{8(D_{y,abdomen}(t+\Delta t) - D_{y,abdomen}(t-\Delta t)) - (D_{y,abdomen}(t+2\Delta t) - D_{y,abdomen}(t-2\Delta t))}{12\Delta t}$$

$$C(t) = \frac{D_{y,abdomen}(t)}{D_{constant}}$$

$Dy_{abdomen}(t)$	Calculated Lateral Abdominal Rib Displacement
Δt	Time step
$D_{constant}$	0.170 for WorldSID

3.6 Lower extremities criteria

3.6.1 Iliac Force Drop

The Iliac Force Drop value is calculated with the following formula:

$$IFD = \max\,(IFD(t))$$

With:

$$IFD(t) = F_{iliac}(t + 0.001s) - F_{iliac}(t)$$

F_{iliac} (t)	Filtered Iliac Force F_{iliac}	??ILAC[LE,RI]00??FOXB

3.6.2 Acetabulum Force

The Resultant Acetabulum Force value is calculated with the following formula for time intervals where $F_{acetabulum,X}$ is in compressive load:

$$F_{acetabulum} = \max\left(\sqrt{F_{acetabulum,X}{}^2 + F_{acetabulum,Y}{}^2 + F_{acetabulum,Z}{}^2}\right)$$

With:

$F_{acetabulum,X}$	Filtered Femur Force $F_{acetabulum,X}$	??ACTB[LE,RI]00T3FOXB
$F_{acetabulum,Y}$	Filtered Femur Force $F_{acetabulum,Y}$	??ACTB[LE,RI]00T3FOYB
$F_{acetabulum,Z}$	Filtered Femur Force $F_{acetabulum,Z}$	??ACTB[LE,RI]00T3FOZB

3.6.3 Knee Displacement

The Knee Displacement value is calculated with the following formula:

$$D_{knee} = |\min(D_{knee}(t))|$$

With:

$D_{knee}(t)$	Filtered Knee Displacement D_{knee}	??KNSL[LE,RI]00??DSXC

3.6.4 Femur Force

The Femur Force value is calculated with the following formula:

$$F_{femur} = \text{abs}\left(\min\left(F_{femur}(t)\right)\right)$$

With:

$F_{femur}(t)$	Filtered Femur Force F_{femur}	??FEMR[LE,RI]00??FOZB

3.6.5 Tibia Index

The Tibia Index is calculated with the following formula:

$$TI(t) = \left|\frac{M_R(t)}{(M_R)_C}\right| + \left|\frac{F_z(t)}{(F_z)_C}\right|$$

with:

$$M_R(t) = \sqrt{M_x(t)^2 + M_y(t)^2}$$

M_x	Filtered Bending Moment M_x	??TIBI[LE,RI][UP,LO]??MOXB
F_z	Filtered Force F_z	??TIBI[LE,RI][UP,LO]??FOZB
$(M_R)_C$	225Nm for HIII-50M & THOR and 115Nm for HIII-05F	
$(F_z)_C$	35.9kN for HIII-50M & THOR and 22.9N for HIII-05F	

3.7 Criteria summary

3.1	Head Criteria	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.1.1	Resultant acceleration	x	x	x	x	x	x	x
3.1.2	HIC15	x	x	x	x	x	x	x
3.1.3	DAMAGE	x						
3.1.4	T HRC					x		
3.1.5	T1 acceleration					x		
3.2	Neck Criteria	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.2.1	Upper neck Mocy		x	x	x			
3.2.2	Upper neck Mocx				x			
3.2.3	Upper neck My	x			x			
3.2.4	Lower neck Mx				x			
3.2.4	Lower neck My				x			
3.2.5	NIC					x		
3.2.6	Nkm					x		
3.3	Shoulder Criteria	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.3.1	Fy shoulder				x			
3.3.2	Dy shoulder rib				x			
3.4	Chest Criteria	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.4.1	Chest deflection HIII		x					
3.4.2	Chest rib THOR	x						
3.4.3	Chest displacement						x	
3.4.4	Seatbelt force	x	x	x				
3.4.5	Dy thorax rib				x			
3.4.6	V*C				x			
3.5	Abdomen Criteria	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.5.1	T12 Resultant accel				x			
3.5.2	Dx abdomen rib	x						
3.5.3	Dy abdomen rib				x			
3.5.4	V*C				x			
3.6	Lower extremities	THOR	HIII 50th	HIII 5th	WorldSID 50th	BioRID	Q10	Q6
3.6.1	Iliac force drop	x		x				
3.6.2	Acetabulum force	x						
3.6.3	Knee displacement	x	x	x				
3.6.4	Femur force	x	x	x				
3.6.5	Tibia index	x	x	x				

4 VEHICLE CRITERIA CALCULATION

This chapter describes the calculation for each vehicle criteria used within Euro NCAP, including the filters that are applied (where applicable) to each channel used in these calculations. The analysis software used by the Euro NCAP labs will follow these calculations in detail.

4.1 Occupant Load Criterion (OLC)

The calculation for the test vehicle and trolley OLC in the MPDB test is as follows.

4.1.1 The filtered acceleration pulse shall be integrated with the following equation to derive the velocity course of the barrier:

$$V_t = \int A_X(t)\, dt + V_0$$

4.1.2 Where V_0 is the initial velocity at $t = 0s$.

4.1.3 $OLC_{SI-unit}$, t_1 and t_2 can be calculated with solving the following equation system:

$$\begin{cases} \int_{t=0}^{t=t_1} V_0\, dt - \int_{t=0}^{t=t_1} V(t)\, dt = 0.065 \\ \int_{t=t_1}^{t=t_2} \left(V_0 - OLC_{SI-unit} \times (t - t_1)\right) dt - \int_{t=t_1}^{t=t_2} V(t)\, dt = 0.235 \\ V_0 - OLC_{SI-unit} \times (t_2 - t_1) = V(t_2) \end{cases}$$

4.1.4 Where:

- t_1 is end of the free-flight-phase of a virtual dummy in vehicle or on the barrier along a displacement of 0.065m, and
- t_2 is end of the restraining-phase of a virtual dummy in vehicle or on the barrier along a displacement of 0.235m after the free-flight-phase (i.e. in total 0.300m displacement for the virtual dummy).

4.1.5 OLC shall be converted from SI units into g (standard gravity) with the conversion factor of 1g = 9.81m/s²

4.2 Compatibility

4.2.1 Compatibility modifier

$$C_{modifier} = OLC_{modifier} + SD_{modifier} + BO_{modifier}$$

with:

$$OLC_{modifier} = \begin{cases} 0 & OLC \leq 25g \\ OLC\% * 2 & 25g < OLC \leq 40g \\ 2 & OLC > 40g \end{cases}$$

$$SD_{modifier} = \begin{cases} SD\% * 2 & OLC \leq 25g \\ SD\% * ([2 + OLC\% * 6] - [OLC\% * 2]) & 25g < OLC \leq 40g \\ SD\% * 6 & OLC > 40g \end{cases}$$

$$OLC\% = \frac{OLC - 25}{40 - 25}$$

$$SD\% = \frac{SD - 50}{150 - 50}$$

where:

$C_{modifier}$	Compatibility modifier in points (capped to a maximum of 8 points)
$OLC_{modifier}$	Occupant Load Criterion modifier based on the OLC of the MPDB trolley in g
$SD_{modifier}$	Standard Deviation modifier based on the deformation of the PDB element
$BO_{modifier}$	Bottoming-Out modifier based on the deformation of the PDB element

Please note, for the purposes of the compatibility modifier, data is required at a sampling rate of 20kHz. The calculation of velocity change (dV), a CFC of 180 shall be used.

5 ASSESSMENT CRITERIA CALCULATION

This chapter describes the calculation for assessment criteria used within Euro NCAP active safety tests, including the filters that are applied to each channel used in these calculations. The analysis software used by the Euro NCAP labs will follow these calculations in detail.

5.1 Autonomous Emergency Braking

5.1.1 Relative impact speed

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

$$v_{rel,impact} = v_{VUT}(t_{impact}) - v_{GVT}(t_{impact})$$

with:

$V_{VUT,x}$	Speed of VUT	10VEHC000000VEXP
$V_{GVT,x}$	Speed of GVT	20VEHC000000VEXP
t_{impact}	Time of impact	10TIMPFR0000EV00

5.1.2 Speed reduction

The speed reduction is calculated with the following formula:

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

with:

$V_{VUT,x}$	Speed of VUT	10VEHC000000VEXP
t_0	Time of start of test	
t_{impact}	Time of impact	10TIMPFR0000EV00

5.1.3 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	10TTTC000000TI00
t_{FCW}	Time of FCW initiation	10TFCW000000EV00

5.2 Lane Support Systems

5.2.1 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	1[1,3]WHEL000000DSYP
y_{line}	Lateral position coordinate of inner edge of line	

5.2.2 Distance to Line Crossing for LDW

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

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

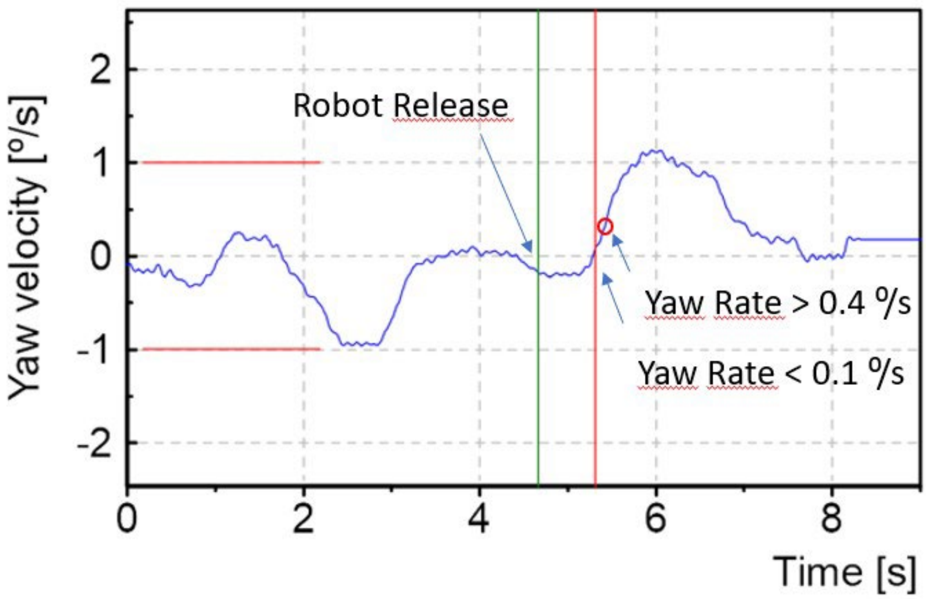
with:

$y_{VUT,wheel}$	Lateral position of the outer edge of wheel	1[1,3]WHEL000000DSYP
t_{LDW}	Time of LDW initiation	10TLDW000000EV00
y_{line}	Lateral position coordinate of inner edge of line	

5.2.3 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 Rate during the LSS manoeuvre:

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



ANNEX I: Active Safety Test Report
Cover Example [ISO 17025:2005]

Test lab logo

[AEBP/AEBB/AEBM/AEBC/LSS**]**
TEST REPORT

[22-BMW-9999-AEBP]
According to protocol: Version 2.0, November 2017

[Vehicle brand and model]

Tests conducted at
[Test laboratory name]

Test Executed by
[Name and signature]

Report reviewed by
[Name and signature]

BMW iX Euro NCAP – AEBP Test Report   Page 1 of 5

Requirements

- Title: Test Report
- Logo: Euro NCAP
- Test method reference (Euro NCAP Protocol Nr.)
- Name and address of lab

- Name of customer
- Date of Report
- Version of Report (updates need to be obvious)
- Date or period of tests
- Reference of the test object (VIN + Software Version)
- Reference to measurement and test equipment (Serial Nr. Calibration Date)
- Reference to environmental conditions
- A statement or overview on the results
- Where appropriate or needed, opinions or interpretations
- Each page should be identified individually (page x of y)
- Validated in 4-eyes principle