Technical Bulletin

Data format and Injury Criteria Calculation

Version 2.0

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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 should 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 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
- 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 2016 with a Euro NCAP internal number of 999.

**MAIN FOLDER NAME**
- <Frontal ODB test number>
- <Frontal FW test number>
- <Side MDB test number>
- <Side Pole test number>
- Whiplash tests folder
- AEB City test folder
- Child Occupant Protection folder
- Pedestrian tests folder
- AEB Pedestrian test folder
- SBR test number
- SAS tests folder
- AEB Inter-Urban tests folder
- LSS tests folder
- Euro NCAP Spreadsheet

**16-VOL-999-Volvo XC90**
- 16-VOL-999-OD1
- 16-VOL-999-FW1
- 16-VOL-999-MD1
- 16-VOL-999-PO1
- 16-VOL-999-WHL
- 16-VOL-999-AEBC
- 16-VOL-999-COP
- 16-VOL-999-PP
- 16-VOL-999-AEBP
- 16-VOL-999-SBR
- 16-VOL-999-SAS
- 16-VOL-999-AEBI
- 16-VOL-999-LSS
- 16-VOL-999-Volvo XC90
1.1.1  **Whiplash sub-test folders**

The Whiplash test folder contains 4 sub-test folders. Three contain the dynamic data from the three dynamic pulses tested; Low, Medium and High. In addition, the rear whiplash data is contained in a separate folder. The static measurement file and whiplash test report will be filed in the main Whiplash folder.

**MAIN FOLDER NAME**

…

Whiplash tests folder
  - <Whiplash Low test number>
  - <Whiplash Medium test number>
  - <Whiplash High test number>
  - <Whiplash Rear test number>
  - Static measurement file
  - Whiplash test report

…

1.1.2  **AEB City sub-test folders**

The number of sub-test folders in the AEB City test folder is depending on the AEB City performance of the vehicle under test. For each speed tested there will be a separate sub-test folder. The AEB City test report will be filed in the main AEB City folder.

The test numbers for each subtest consists of the AEB City scenario CCRs followed by the test speed.

**MAIN FOLDER NAME**

…

AEB City tests folder
  - <AEB City CCRs 10km/h>
  - <AEB City CCRs 15km/h>
  - …
  - <AEB City CCRs 50km/h>
  - AEB City test report

…
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
…
```

**COP tests folder**

```
16-VOL-999-Volvo XC90
…
16-VOL-999-COP
  CRS installation
  Vehicle based assessment
  Manual & CRS vehicle lists
  16-VOL-999-COP
…
```

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. 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 subtest consists of the Euro NCAP test number followed by the GRID point label.

The test report in the main report folder should contain all plots of all tests combined in one file called (16-VOL-999-PP).

**MAIN FOLDER NAME**

```
…
Pedestrian tests folder
  Document
  Movie
  Photo
  Report
    Pedestrian test report
  Static
  Test data
    <Adult Headform test number>
    <Child Headform test number>
    …
    <Legform test number>
    …
    <Lower legform test number>
    Channel
    Photo
      MME-file
…
```

**Pedestrian tests folder**

```
16-VOL-999-Volvo XC90
…
16-VOL-999-PP
  Document
  Movie
  Photo
  Report
    16-VOL-999-PP
  Static
  Test data
    16-VOL-999-PP-A10-5
    16-VOL-999-PP-C3+1
    …
    16-VOL-999-PP-U+2
    …
    16-VOL-999-PP-L-4
    Channel
    Photo
      16-VOL-999-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 speed tested in each scenario there will be a separate sub-test folder. The AEB Pedestrian test report will be filed in the main AEB Pedestrian folder.

The test numbers for each subtest consists of the AEB Pedestrian scenario (CVFA, CVNA-25, CVNA-75, CVNC) followed by the test speed. Where a certain test speed is repeated three times as per AEB Pedestrian test protocol, add the repetition number.

**MAIN FOLDER NAME**

- AEB Pedestrian tests folder
  - <AEB-P CVNA75 3km/h test number>
  - <AEB-P CVNA75 10km/h test number>
  - <AEB-P CVNA75 15km/h test number>
  - <AEB-P CVFA 20km/h test number>
  - ...
  - <AEB-P CVNA25 20km/h test number>
  - <AEB-P CVNA25 20km/h test number>
  - <AEB-P CVNA25 20km/h test number>
  - ...
  - <AEB-P CVNA75 20km/h test number>
  - ...
  - <AEB-P CVNC 20km/h test number>
  - ...
- AEB Pedestrian test report
- ...

**16-VOL-999-Volvo XC90**

- 16-VOL-999-AEBP
  - CVNA75-3
  - CVNA75-10
  - CVNA75-15
  - CVFA-20
  - ...
  - CVNA25-20-1
  - CVNA25-20-2
  - CVNA25-20-3
  - ...
  - CVNA75-20
  - ...
  - CVNC-20
  - ...
- 16-VOL-999-AEBP Test Report
- ...

---

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1.1.6 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.

- **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

1.1.7 AEB Inter-Urban sub-test folders

The number of sub-test folders in the AEB Inter-Urban test folder is depending on the AEB Inter-Urban performance of the vehicle under test. For each speed tested in each scenario there will be a separate sub-test folder. The AEB Inter-Urban test report will be filed in the main AEB Inter-Urban folder.

The test numbers for each subtest consists the AEB Inter-Urban scenario (CCRs, CCRm, CCRb), than the system used in the test (AEB, FCW) followed by the test speed. In case of the CCRb scenario the distance and brake EVT brake level.

- **MAIN FOLDER NAME**
  - AEB Inter-Urban tests folder
    - <AEB-IU CCRs FCW 30km/h test number>
    - <AEB-IU CCRm AEB 30km/h test number>
    - ...
    - <AEB-IU CCRm FCW 30km/h test number>
    - ...
    - <AEB-IU CCRb AEB 12-2 test number>
    - ...
    - <AEB-IU CCRb AEB 40-6 test number>
    - <AEB-IU CCRb FCW 12-2 test number>
    - ...
    - <AEB-IU CCRb FCW 40-6 test number>
    - AEB Inter-Urban test report

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1.1.8 Lane Support Systems sub-test folders

The number of sub-test folders in the Lane Support Systems test folder is depending on the LKA performance of the vehicle under test. For each speed tested in each scenario there will be a separate sub-test folder. The Lane Support Systems test report will be filed in the main Lane Support Systems folder.

The test numbers for each subtest consists of the Lane Support Systems scenario (LDW-SL, LDW-DL, LKA-SL), the lateral velocity and finally followed by the letter indicating left or right.

```
1. MAIN FOLDER NAME
   ...
   Lane Support Systems tests folder
   <LSS LDW-SL 0.3 left test number>
   ...
   <LSS LDW-SL 0.5 right test number>
   <LSS LDW-DL 0.3 left test number>
   ...
   <LSS LDW-DL 0.5 right test number>
   <LSS LKA-SL 0.1 left test number>
   ...
   <LSS LKA-SL 0.5 right test number>
   <LSS LKA-SL 0.6 left test number>
   ...
   <LSS LKA-SL 1.0 right test number>
   LSS test report
   ...

2. 16-VOL-999-Volvo XC90
   ...
   16-VOL-999-LSS
   ...
   LDW-SL-03L
   ...
   LDW-SL-05R
   ...
   LDW-DL-03L
   ...
   LDW-DL-05R
   ...
   LKA-SL-01L
   ...
   LKA-SL-05R
   ...
   LKA-SL-06L
   ...
   LKA-SL-10R
   16-VOL-999-LSS Test Report
   ...
```
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 is 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
  - `<name of document file 1>`
  - `<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
    - <name of movie file 1>
    - <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
      - <name of photo file 1>
      - <name of photo file p>
    - After
      - <name of photo file 1>
      - <name of photo file p>
  - …

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

- TEST NUMBER
  - …
  - Report
    - <name of test report>
    - <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.

- TEST NUMBER
  - …
  - Static
    - <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 the following header:

<table>
<thead>
<tr>
<th>Data format edition number</th>
<th>1.6</th>
</tr>
</thead>
</table>

...  

<table>
<thead>
<tr>
<th>Customer name</th>
<th>Euro NCAP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer test ref number</td>
<td><code>&lt;test number&gt;</code></td>
</tr>
<tr>
<td>Title</td>
<td>Euro NCAP <code>&lt;year of test&gt;</code></td>
</tr>
<tr>
<td>Type of the test</td>
<td><code>&lt;see table&gt;</code></td>
</tr>
<tr>
<td>Subtype of the test</td>
<td><code>&lt;see table&gt;</code></td>
</tr>
<tr>
<td>Regulation</td>
<td><code>&lt;test protocol version&gt;</code></td>
</tr>
<tr>
<td>Name of test object 1</td>
<td><code>&lt;make and model&gt;</code></td>
</tr>
<tr>
<td>Class of test object 1</td>
<td><code>&lt;Euro NCAP vehicle class&gt;</code></td>
</tr>
<tr>
<td>Ref. number of test object 1</td>
<td><code>&lt;VIN number&gt;</code></td>
</tr>
</tbody>
</table>

...  

<table>
<thead>
<tr>
<th><strong>Euro NCAP test</strong></th>
<th><strong>Type of Test</strong></th>
<th><strong>Subtype of test</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Frontal ODB</td>
<td>Frontal Impact</td>
<td>ODB</td>
</tr>
<tr>
<td>Frontal FW</td>
<td>Frontal Impact</td>
<td>FW</td>
</tr>
<tr>
<td>Side MDB</td>
<td>Side Impact</td>
<td>AE-MDB</td>
</tr>
<tr>
<td>Side Pole</td>
<td>Side Impact</td>
<td>Pole 75 degree</td>
</tr>
<tr>
<td>Whiplash</td>
<td>Rear Sled Test</td>
<td>Whiplash-LowPulse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Whiplash-MediumPulse</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Whiplash-High</td>
</tr>
<tr>
<td>Pedestrian</td>
<td>Pedestrian</td>
<td>Adult Headform</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Child Headform</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Upper Legform</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lower Legform</td>
</tr>
<tr>
<td>AEB City</td>
<td>AEB</td>
<td>CCRs</td>
</tr>
<tr>
<td>AEB Pedestrian</td>
<td>AEB</td>
<td>CVFA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CVNA-25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CVNA-75</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CVNC</td>
</tr>
<tr>
<td>AEB Inter-Urban</td>
<td>AEB</td>
<td>CCRs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CCRm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CCRb</td>
</tr>
<tr>
<td>Lane Support Systems</td>
<td>LSS</td>
<td>LDW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LKA</td>
</tr>
</tbody>
</table>
## 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

<table>
<thead>
<tr>
<th>Location</th>
<th>Parameter</th>
<th>ISO code</th>
<th>CFC</th>
<th>Injury Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Head</td>
<td>Accelerations, $A_x$, $A_y$, $A_z$</td>
<td>??HEAD0000H3AC[XY]P</td>
<td>1000</td>
<td>Peak Resultant acceleration HIC$_{15}$ Readult 3ms cumulative exceedence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Resultant 3ms cumulative exceedence</td>
</tr>
<tr>
<td>Neck</td>
<td>Forces, $F_x$, $F_y$, $F_z$</td>
<td>??NECKUP00H3FO[XY]P</td>
<td>1000</td>
<td>Tension continuous exceedence</td>
</tr>
<tr>
<td></td>
<td>Moments, $M_x$, $M_y$, $M_z$</td>
<td>??NECKUP00H3MO[XY]P</td>
<td>600</td>
<td>Shear ($F_y$) continuous exceedence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Peak Extension ($M_z$)</td>
</tr>
<tr>
<td>Chest</td>
<td>Accelerations, $A_x$, $A_y$, $A_z$</td>
<td>??CHST0000H3AC[XY]P</td>
<td>180</td>
<td>Peak resultant acceleration Viscous Criterion</td>
</tr>
<tr>
<td></td>
<td>Deflection, $D_{\text{chest}}$</td>
<td>??CHST003H3DSXP</td>
<td>180</td>
<td>Resultant 3ms cumulative exceedence</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Peak deflection</td>
</tr>
<tr>
<td>Pelvis</td>
<td>Accelerations, $A_x$, $A_y$, $A_z$</td>
<td>??PELV0000H3AC[XY]P</td>
<td>600</td>
<td>Viscous Criterion</td>
</tr>
<tr>
<td>Lumbar Spine</td>
<td>Forces, $F_x$, $F_z$</td>
<td>??LUSP0000H3FO[XY]P</td>
<td>600</td>
<td>Compressive Axial Force (-$F_z$) continuous exceedence</td>
</tr>
<tr>
<td></td>
<td>Moments, $M_y$</td>
<td>??LUSP0000H3MOYP</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Femurs (L &amp; R)</td>
<td>Forces, $F_z$</td>
<td>??FEMR[LE,RI]00H3FOZP</td>
<td>600</td>
<td>Peak displacement (-D)</td>
</tr>
<tr>
<td>Knees (L &amp; R)</td>
<td>Displacements, $D_{\text{knee}}$</td>
<td>??KNSL[LE,RI]00H3DSXP</td>
<td>180</td>
<td>Peak Tibia Compression (-$F_z$) Tibia Index</td>
</tr>
<tr>
<td>Upper Tibia (L &amp; R)</td>
<td>Forces, $F_x$, $F_y$</td>
<td>??TIBI[LE,RI]UPH3FO[XY]P</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moments, $M_x$, $M_y$</td>
<td>??TIBI[LE,RI]UPH3MO[XY]P</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Lower Tibia (L &amp; R)</td>
<td>Forces, $F_x$, $F_y$ ($F_z$)</td>
<td>??TIBI[LE,RI]LOH3FO[XY]P</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moments, $M_x$, $M_y$</td>
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## 2.2 Hybrid III 5% Female

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<td>Accelerations, A_x A_y A_z</td>
<td>??HEAD0000HFAC[X,Y,Z]P</td>
<td>1000</td>
<td>Peak Resultant acceleration HIC_15 Resultant 3ms cumulative exceedence</td>
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<td>Peak Extension (M_y)</td>
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<td>Lumbar Spine</td>
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<td>Forces, F_z</td>
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<td>Knees (L &amp; R)</td>
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<td>Upper Tibia (L &amp; R)</td>
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## 2.3 WorldSID 50% Male

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<td>Absolute Length, R</td>
<td>??SHRI[LE,RI]00WSDC0P</td>
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<td>Shoulder</td>
<td>Forces, F_x, F_y, F_z</td>
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<td>Femoral Neck</td>
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## 2.4 BioRID-II

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<td>NIC</td>
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<td>Velocity, V&lt;sub&gt;x&lt;/sub&gt;</td>
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<td>Head rebound velocity</td>
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<td>Contact</td>
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<td>Head contact time</td>
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<td>Cervical Spine</td>
<td>Accelerations, A&lt;sub&gt;x&lt;/sub&gt;, A&lt;sub&gt;z&lt;/sub&gt;</td>
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<tr>
<td>Neck Upper</td>
<td>Forces, F&lt;sub&gt;x&lt;/sub&gt;, F&lt;sub&gt;y&lt;/sub&gt;, F&lt;sub&gt;z&lt;/sub&gt;</td>
<td>1000</td>
<td>Nkm Neck shear (+Fx) Neck tension (+Fz)</td>
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<td>Moments, M&lt;sub&gt;x&lt;/sub&gt;, M&lt;sub&gt;y&lt;/sub&gt;, M&lt;sub&gt;z&lt;/sub&gt;</td>
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<td>Moments, M&lt;sub&gt;x&lt;/sub&gt;, M&lt;sub&gt;y&lt;/sub&gt;, M&lt;sub&gt;z&lt;/sub&gt;</td>
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<td>Thoracic Spine</td>
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<td>T&lt;sub&gt;1&lt;/sub&gt;- X-acceleration NIC</td>
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<td>T8</td>
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<td>Lumbar Spine</td>
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<tr>
<td>Pelvis</td>
<td>Accelerations, A&lt;sub&gt;x&lt;/sub&gt;, A&lt;sub&gt;y&lt;/sub&gt;, A&lt;sub&gt;z&lt;/sub&gt;</td>
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### 2.5 Q6

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<th>Injury Calculation</th>
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<td>$\text{HIC}_{15}$ Resultant 3ms exceedance (cumulative)</td>
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<tr>
<td>Neck Upper</td>
<td>Forces, $F_x, F_y, F_z$</td>
<td>??NECKUP00Q6FO[X,Y,Z]P</td>
<td>1000</td>
<td>Peak Tensile Force $F_z$ Resultant Force (side)</td>
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<td></td>
<td>??NECKUP00Q6MO[X,Y,Z]P</td>
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<tr>
<td>Thorax</td>
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### 2.6 Q10

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<td>$\text{HIC}_{15}$ Resultant 3ms exceedance (cumulative)</td>
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<tr>
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<td>Peak Tensile Force $F_z$ Resultant Force (side)</td>
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<td>??NECKUP00QAMO[X,Y,Z]P</td>
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<tr>
<td>Shoulder (side only)</td>
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<td>Chest (side only)</td>
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<td>Rotation, $\alpha$</td>
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<td>Lumbar Spine</td>
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<td>Pelvis-Sacrum</td>
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<td>Pelvis-Pubis (side only)</td>
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### 2.7 Adult Headform

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### 2.8 Small Adult / Child Headform

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### 2.9 Upper Legform

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<td>D0FEMR[UP,MI,LO]00PUMOYP</td>
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### 2.10 Lower Legform (Flex-PLI)

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<td>Tibia Bending Moment</td>
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### 2.11 Vehicle for Passive Safety tests

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### 2.12 Trolley

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### 2.13 Sled

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### 2.14 Vehicle for Active Safety tests

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<td>FCW activation time</td>
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<td>Line crossing time</td>
<td>10TLCRFR[LE,RI]00EV00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle Front</td>
<td>Position $X_{\text{VUT}}, Y_{\text{VUT}}$</td>
<td>10VEHC000000DS[X,Y]P</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Speed $V_{\text{VUT},x}$, $V_{\text{VUT},y}$</td>
<td>10VEHC000000VE[X,Y]P</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Acceleration $A_{\text{VUT}}$</td>
<td>10VEHC000000ACXP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yaw velocity $\Psi_{\text{VUT}}$</td>
<td>10VEHC000000AVZP</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle front wheel (outer edge)</td>
<td>Position $X_{\text{VUT, wheel}}, Y_{\text{VUT, wheel}}$</td>
<td>1[1,3]WHEL000000DS[X,Y]P</td>
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<td></td>
</tr>
<tr>
<td>Steering wheel</td>
<td>Steering wheel velocity</td>
<td>10STWL000000AV1P</td>
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<td></td>
</tr>
<tr>
<td>Accelerator pedal</td>
<td>Pedal position</td>
<td>10PEAC000000DS0P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brake pedal</td>
<td>Pedal position</td>
<td>10PEBR000000DS0P</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Pedal Force</td>
<td>10PEBR000000FO0P</td>
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### 2.15 Euro NCAP Vehicle Target

<table>
<thead>
<tr>
<th>Location</th>
<th>Parameter</th>
<th>ISO code</th>
<th>CFC</th>
<th>Assessment Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EVT</td>
<td>Position $X_{\text{EVT}}, Y_{\text{EVT}}$</td>
<td>20VEHC000000DS[X,Y]P</td>
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<tr>
<td></td>
<td>Speed $V_{\text{EVT},x}$, $V_{\text{EVT},y}$</td>
<td>20VEHC000000VE[X,Y]P</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Acceleration $A_x$</td>
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<td></td>
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<tr>
<td></td>
<td>Yaw velocity $\Psi_{\text{EVT}}$</td>
<td>20VEHC000000AVZP</td>
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</table>

Version 2.0
February 2017
## 2.16 Euro NCAP Pedestrian Target

<table>
<thead>
<tr>
<th>Location</th>
<th>Parameter</th>
<th>ISO code</th>
<th>CFC</th>
<th>Assessment Calculation</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPT adult &amp; child</td>
<td>Position $Y_{EPT}$</td>
<td>20PED[A,C]000000DCYP</td>
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<tr>
<td></td>
<td>Speed $V_{EPT,Y}$</td>
<td>20PED[A,C]000000VEYP</td>
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</table>
3 INJURY CRITERIA CALCULATION
This chapter describes the calculation for each injury criteria 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.

For all of the calculations and for all of the dummies used, only the loading phase of the crash is considered. 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 0 after the minimum acceleration peak value.

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 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.
3.1.4 **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
- \(T1_{right}\) Filtered right T1 acceleration

3.2 **Neck criteria**

3.2.1 **Neck extension bending moment**

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
- \(F_x\) Filtered Shear Force
- \(d\) \(0.01778\)m for HIII-50M and HIII-05F

3.2.2 **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 \(A_x\)
3.2.3 Nkm
The Nkm value is calculated with the following formula:

\[ N_{km}(t) = N_{ep}(t) + N_{ea}(t) + N_{fp}(t) + N_{fa}(t) \]

with:

\[ N_{ep}(t) = \frac{M_{ye}(t)}{-47.5} + \frac{F_{xp}(t)}{-845} \]
\[ N_{ea}(t) = \frac{M_{ye}(t)}{-47.5} + \frac{F_{xa}(t)}{845} \]
\[ N_{fp}(t) = \frac{M_{yf}(t)}{88.1} + \frac{F_{xp}(t)}{-845} \]
\[ N_{fa}(t) = \frac{M_{yf}(t)}{88.1} + \frac{F_{xa}(t)}{845} \]

\[ M_{OCY}(t) = M_{y}(t) - D \cdot F_{x}(t) \]

F_y Filtered Upper Neck Shear Force F_y
M_y Filtered Upper Neck Moment M_y
D 0.01778m

\[ F_{xp}(t) \] negative portion of \( F_x(t) \)
\[ F_{xa}(t) \] positive portion of \( F_x(t) \)
\[ M_{yp}(t) \] 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:

\[ F_{y_{shoulder}} = \max(F_y(t)) \]

with:

\[ F_y \] Filtered Shoulder Force F_y
3.3.2 **Lateral Shoulder Rib Displacement**

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

\[ D_{y,shoulder} = \max(D_y(t) - D_y(0)) \]

with:

\[ D_y(t) = R(t) \cdot \sin(\Phi_{IRT}(t)) \]

R(t) Filtered Shoulder IR-TRACC length ??SHRI[LE,RI]00WSDC0C

\[ \Phi_{IRT}(t) \] Filtered Shoulder IR-TRACC rotation ??SHRI[LE,RI]00WSANZC

D_y(0) Lateral Shoulder Rib Displacement @ t=0

3.4 **Chest criteria**

3.4.1 **Chest Deflection**

The Chest Deflection value is calculated with the following formula:

\[ D_{chest} = \max(D_{chest}(t)) \]

with:

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

3.4.2 **Seatbelt force modifier**

The Seatbelt force modifier is calculated with the following formula:

\[ MA_{seatbelt} = \max(MA_{seatbelt}(t)) \]

with:

\[ MA_{seatbelt}(t) = \frac{1}{2n+1} \sum_{j=t-n}^{t+n} F_{seatbelt}(j) \]

F_{seatbelt} Filtered Seatbelt Force ??SEBE0003B3FO0D

n number of samples equivalent to 10ms

3.4.3 **Lateral Thoracic Rib Displacement**

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

\[ D_{y,torax} = \max(D_y(t) - D_y(0)) \]

with:

\[ D_y(t) = R(t) \cdot \sin(\Phi(t)) \]

R(t) Filtered Thoracic IR-TRACC length ??TRRI[LE,RI]01WSDC0C

\[ \Phi(t) \] Filtered Thoracic IR-TRACC rotation ??TRRI[LE,RI]01WSANZC

D_y(0) Lateral Thoracic Rib Displacement @ t=0
3.4.4  **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
- \( \Delta t \): 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
- \( A_y \): Filtered T12 Acceleration
- \( A_z \): Filtered T12 Acceleration

3.5.2  **Lateral Abdominal Rib Displacement**

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

\[ D_y_{abdomen} = \max(D_y(t) - D_y(0)) \]

with:

- \( D_y(t) = R(t) \cdot \sin(\Phi(t)) \)
- \( R(t) \): Filtered Abdominal IR-TRACC length
- \( \Phi(t) \): Filtered Abdominal IR-TRACC rotation
- \( D_y(0) \): Lateral Abdominal Rib Displacement @ \( t=0 \)

3.5.3  **Viscous Criterion**
The VC is calculated with the following formula:

\[ VC = sf \cdot V(t) \times C(t) \]

With:
\[ sf = 1.0 \text{ for WorldSID} \]
\[ V(t) = \frac{8(D_{y,abdomen}(t+1) - D_{y,abdomen}(t-1)) - (D_{y,abdomen}(t+2) - D_{y,abdomen}(t-2))}{12\Delta t} \]
\[ C(t) = \frac{D_{y,abdomen}(t)}{D_{constant}} \]

\( D_{y,abdomen}(t) \) Calculated Lateral Abdominal Rib Displacement
\( \Delta t \) 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:
\[ IFD(t) = F_{iliac}(t + 0.001) - F_{iliac}(t) \]
\( F_{iliac}(t) \) Filtered Iliac Force

#### 3.6.2 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

#### 3.6.3 Femur Force

The Femur Force value is calculated with the following formula:

\[ F_{femur} = \abs(\min(F_{femur}(t))) \]

With:
\( F_{femur}(t) \) Filtered Femur Force
3.6.4 Tibia Index

The Tibia Index is calculated with the following formula:

\[ TI(t) = \frac{|M_R(t)|}{(M_R)_C} + \frac{|F_z(t)|}{(F_z)_C} \]

with:

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

\[ M_x \quad \text{Filtered Bending Moment} \quad \text{MOX} \]
\[ F_z \quad \text{Filtered Force} \quad \text{FOZ} \]

\[(M_R)_C \quad 225 \text{Nm for HIII-50M and 115Nm for HIII-05F} \]
\[(F_z)_C \quad 35.9kN \text{ for HIII-50M and 22.9N for HIII-05F} \]
4 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.

4.1 Autonomous Emergency Braking

4.1.1 Relative impact speed

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

\[ v_{rel,impact} = v_{VUT}(t_{impact}) - v_{EVT}(t_{impact}) \]

with:

- \( V_{VUT,x} \) Speed of VUT 10VEHC000000VEXP
- \( V_{EVT,x} \) Speed of EVT 20VEHC000000VEXP
- \( t_{impact} \) Time of impact 10TIMPFR0000EV00

4.1.2 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 10TIMPFR0000EV00
- \( t_{impact} \) Time of impact 10TIMPFR0000EV00

4.1.3 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 10TTC000000TI00
- \( t_{FCW} \) Time of FCW initiation 10TFCW000000EV00

4.2 Lane Support Systems

4.2.1 Distance to Line Crossing for LKA

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

\[ DTLC_{LKA} = \max(y_{VUT,\text{wheel}}) - y_{\text{line}} \]

with:

- \( y_{VUT,\text{wheel}} \) Lateral position of the outer edge of wheel 1[1,3]WHEL000000DSYP
- \( y_{\text{line}} \) Lateral position coordinate of inner edge of line
4.2.2 Distance to Line Crossing for LDW

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

\[ D_{DLC_{LDW}} = y_{VUT,\text{wheel}}(t_{LDW}) - y_{\text{line}} \]

with:

- \( y_{VUT,\text{wheel}} \): Lateral position of the outer edge of wheel
- \( t_{LDW} \): Time of LDW initiation
- \( y_{\text{line}} \): Lateral position coordinate of inner edge of line