FOR SAFER CARS
EURO NCAP
Euro NCAP 2018 5-Star Requirements

Aled Williams

Asta Zero Testers’ Day
25th April 2017
CONTENT

- INTRODUCTION
- 2018 ACTIVE SAFETY TESTING
  - AEB CAR TO CAR
  - AEB VRU
  - LANE SUPPORT SYSTEMS
  - SPEED ASSISTANCE SYSTEMS
- 2018 OVERALL RATING SCHEME
- CONCLUDING REMARKS
Currently 11 Members of Staff:  
• Managerial  
• Technical  
• Administrative

Mgr. Ladeuzeplein 10  
3000 Leuven  
Belgium
New Car Assessment in Europe

Euro NCAP is a public-private partnership that has been providing consumer information since 1997.
Most new car models carry a rating

Presence in all popular segments provides a total view of the market and is a good barometer of the present fleet

94% of new cars sold* in EU28 hold a valid Euro NCAP safety rating

75% SOLD

16% SOLD

3% SOLD

≤ ** ** ** **

*Passenger Car & SUV Sales, 2016 up to Q3, 11,435,596 units

2016. Left-Lane.com

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Overall Safety Rating

The star rating combines crash protection, crash avoidance and driver assistance

Overall rating ★★★★★

4 areas

17 tests

Offset Deformable Barrier, Side Pole, CRS Installation Check, Head Impact, Lower Leg Impact, Speed Assistance, Lane Support, Full Width Rigid Barrier, Side Mobile Barrier, CRS Performance, Upper Leg Impact, Seatbelt Reminders, AEB Interurban, Whiplash, AEB City, Vehicle Provisions
2016 AEB Car-to-car

Scenarios and speeds

- City
  - CCRs AEB

- Inter-Urban
  - CCRs FCW
  - CCRm AEB / FCW
  - CCRb AEB / FCW
2018 AEB Car-to-car

Scenarios and speeds

**CCRs**
- Overlaps -50% to 50%
- AEB: 10-50km/h
- FCW: 30-80km/h

**CCRm**
- Overlaps -50% to 50%
- AEB: 30-80km/h
- FCW: 50-80km/h

**CCRb**
- 100% Overlap only
- AEB and FCW: 12m/40m 6ms⁻²/2ms⁻²
2018 AEB Car-to-car

### Lateral Overlaps – CCRs and CCRm

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>-50%</td>
<td>GVT left outer edge VUT centerline</td>
</tr>
<tr>
<td>-75%</td>
<td>GVT centerline VUT centerline</td>
</tr>
<tr>
<td>100%</td>
<td>GVT centerline VUT centerline</td>
</tr>
<tr>
<td>+75%</td>
<td>GVT right outer edge VUT centerline</td>
</tr>
<tr>
<td>+50%</td>
<td>GVT right outer edge VUT centerline</td>
</tr>
</tbody>
</table>
The Grid Scoring System

Thresholds for Colour Boundaries

<table>
<thead>
<tr>
<th>Test Speed [km/h]</th>
<th>50 km/h</th>
<th>45 km/h</th>
<th>40 km/h</th>
<th>35 km/h</th>
<th>30 km/h</th>
<th>25 km/h</th>
<th>20 km/h</th>
<th>15 km/h</th>
<th>10 km/h</th>
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</thead>
<tbody>
<tr>
<td>CCRs Impact Speed [km/h]</td>
<td>Green</td>
<td>Yellow</td>
<td>Orange</td>
<td>Brown</td>
<td>Red</td>
<td>Green</td>
<td>Yellow</td>
<td>Orange</td>
<td>Brown</td>
</tr>
<tr>
<td>Nr of points:</td>
<td>1.000</td>
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<td>1.000</td>
<td>2.000</td>
<td>2.000</td>
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<tr>
<td>Scaling</td>
<td>1.000 points</td>
<td>0.750 points</td>
<td>0.500 points</td>
<td>0.250 points</td>
<td>0.000 points</td>
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<td></td>
<td></td>
<td></td>
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</table>

14.000
2018 AEB Car-to-car

The Grid Scoring System

---

**Overlap**

- **Test Speed**
  - 10 km/h
  - 15 km/h
  - 20 km/h
  - 25 km/h
  - 30 km/h
  - 35 km/h
  - 40 km/h
  - 45 km/h
  - 50 km/h

**Predicted AEB City score**

- **Predictions**
  - **CCR**s: 6
  - **Green**: 3
  - **Yellow**: 1
  - **Orange**: 1
  - **Brown**: 1
  - **Red**: 1

- **Points**:
  - **Green**: 1.000 point
  - **Yellow**: 0.750 points
  - **Orange**: 0.500 points
  - **Brown**: 0.250 points
  - **Red**: 0.000 points

**30km/h: 3 Green, 1 Yellow, 1 Orange, 1 Red**

\[
\frac{(3 \times 1) + (1 \times 0.75) + (1 \times 0.5) + (1 \times 0)}{6} = 0.7083
\]

\[0.7083 \times 2 = 1.417\]

**TOTAL IS SUM SCALED BY 4/14**
2018 AEB Car-to-car

The Grid Scoring System

<table>
<thead>
<tr>
<th>TESTPOINT</th>
<th>PREDICTION</th>
<th>POINTS</th>
<th>IMPACT SPEED</th>
<th>POINTS</th>
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<tr>
<td>50,75</td>
<td>0.250</td>
<td>0.500</td>
<td>27.58</td>
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<tr>
<td>35,100</td>
<td>0.750</td>
<td>0.750</td>
<td>3.01</td>
<td>0.750</td>
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<td>30,100</td>
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<td>1.000</td>
<td>6.99</td>
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<td>30,75</td>
<td>0.750</td>
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<td>0.00</td>
<td>1.000</td>
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<tr>
<td>50,100</td>
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<td>0.250</td>
<td>29.85</td>
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<td>25,50</td>
<td>0.500</td>
<td>0.500</td>
<td>8.00</td>
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<tr>
<td>45,100</td>
<td>0.500</td>
<td>0.500</td>
<td>27.58</td>
<td>0.500</td>
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<tr>
<td>30,50</td>
<td>0.500</td>
<td>0.500</td>
<td>12.85</td>
<td>0.750</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>5.750</strong></td>
<td></td>
<td><strong>6.000</strong></td>
<td></td>
</tr>
</tbody>
</table>

45 km/h 100%

Prediction
Green: $0 \leq \text{V}_{\text{impact}} < 5$
Yellow: $5 \leq \text{V}_{\text{impact}} < 15$
Orange: $15 \leq \text{V}_{\text{impact}} < 25$
Brown: $25 \leq \text{V}_{\text{impact}} < 35$
Red: $35 \leq \text{V}_{\text{impact}}$

Corrected Score

$\text{Correction Factor} = \frac{\text{Actual Tested Score}}{\text{Predicted Score}} = \frac{6.000}{5.750} = 1.043$

The FINAL AEB City score is: $2.845 \times 1.043 = 2.968$ points
2018 AEB Car-to-Car

AEB Interurban scored in a very similar way

Correction factor derived for AEB (CCRs and CCRb)
Correction factor derived for FCW (CCRs, CCRm and CCRb)

Score = AEB Prediction x AEB Correction x 1.5 + FCW Prediction x FCW Correction x 1.0 + HMI x 0.5
2018 AEB Car-to-car

Other details

• Preconditions:
  • In the City Test the vehicle must avoid a collision up to 20km/h at all overlaps
  • Default on and switch off procedure as current protocol
  • FCW must be have a ‘clear and loud’ audible element to be considered
• HMI points as 2016 protocol – Supplementary warning, Active restraint
• As standard: 10 City Test Runs, 10 IU AEB, 10 IU FCW
  • Manufacturer can pay for additional 10 of each.
  • If no predicted data, test all points (assuming symmetry) at Manufacturers cost

• Conditioning now in line with other tests.
AEB Car-to-car Comparison

2016
- City
  - Min Runs: 5
  - Max Runs: 9
- Inter-Urban
  - Min Runs: 16
  - Max Runs: 35
- EVT, Disco 3, I.U. Rig, 2 Robots
- 2 Days

2018
- City
  - Min Runs: 10
  - Max Runs: 45
- Inter-Urban
  - Min Runs: 20
  - Max Runs: 153
- GVT Robotic Platform, 1 Robot
- 2(?) Days
What do we need?

- 2018 Requirements

- Platform: ABD, DSD
- Target and appropriate spares: DRI, 4a (soon)
2018 AEB Car-to-car

GVT = Global Vehicle Target
### Current Test Scenarios

<table>
<thead>
<tr>
<th></th>
<th>CVFA</th>
<th>CVNA-25</th>
<th>CVNA-75</th>
<th>CVNC</th>
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<tbody>
<tr>
<td>VUT speed</td>
<td>20-60 km/h</td>
<td>20-60 km/h</td>
<td>20-60 km/h</td>
<td>20-60 km/h</td>
</tr>
<tr>
<td>Ped speed</td>
<td>8 km/h</td>
<td>5 km/h</td>
<td>5 km/h</td>
<td>5 km/h</td>
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<tr>
<td>Obstruction</td>
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<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Impact point</td>
<td>50%</td>
<td>25%</td>
<td>75%</td>
<td>50%</td>
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<tr>
<td>AEB/FCW</td>
<td>AEB</td>
<td>AEB</td>
<td>AEB</td>
<td>AEB</td>
</tr>
</tbody>
</table>

![Diagram of test scenarios](image)
2018 AEB VRU

2018 Changes

• Changes to naming convention: V (Vulnerable road user) replaced by P (Pedestrian) or B (Bicyclist) where appropriate.
  • CVNA → CPNA, CVFA → CPFA

• Addition of Longitudinal Pedestrian Scenario: CPLA – AEB and FCW
  • All current scenarios kept and unchanged

• Low light assessment

• Cyclist scenarios
## 2018 AEB VRU

Additional Car-Pedestrian Tests 2018

<table>
<thead>
<tr>
<th>2016</th>
<th>2018</th>
<th>CPLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>CVFA</td>
<td>CPFA</td>
<td>VUT speed</td>
</tr>
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<td>CPNA-25</td>
<td>20-60 km/h</td>
</tr>
<tr>
<td>CVNA-75</td>
<td>CPNA-75</td>
<td>50-80 km/h</td>
</tr>
<tr>
<td>CVNC</td>
<td>CPNC</td>
<td>Ped speed</td>
</tr>
<tr>
<td></td>
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<td>5 km/h</td>
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<tr>
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<td></td>
<td>No</td>
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<tr>
<td></td>
<td></td>
<td>Impact point</td>
</tr>
<tr>
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<td>50%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>25%</td>
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<tr>
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<td></td>
<td>AEB/FCW</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AEB</td>
</tr>
<tr>
<td></td>
<td></td>
<td>FCW</td>
</tr>
</tbody>
</table>

2016 CVFA, 2018 CPFA
2016 CVNA-25, 2018 CPNA-25
2016 CVNA-75, 2018 CPNA-75
2016 CVNC, 2018 CPNC
## 2018 AEB VRU

### Car-Pedestrian Low Light

<table>
<thead>
<tr>
<th></th>
<th>CPNA-25</th>
<th>CPNA-75</th>
<th>CPLA</th>
</tr>
</thead>
<tbody>
<tr>
<td>VUT speed</td>
<td>20-60 km/h</td>
<td>20-60 km/h</td>
<td>20-60 km/h</td>
</tr>
<tr>
<td>Ped speed</td>
<td>5 km/h</td>
<td>5 km/h</td>
<td>5 km/h</td>
</tr>
<tr>
<td>Obstruction</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Impact point</td>
<td>25%</td>
<td>75%</td>
<td>50%</td>
</tr>
<tr>
<td>AEB/FCW</td>
<td>AEB</td>
<td>AEB</td>
<td>AEB</td>
</tr>
</tbody>
</table>

**Street Lighting**

**No Artificial Light**
# 2018 AEB VRU

## PEDESTRIAN PROTECTION – AEB BICYCLIST

<table>
<thead>
<tr>
<th></th>
<th>CBNA</th>
<th>CBLA</th>
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<tbody>
<tr>
<td>VUT speed</td>
<td>20 - 60 km/h</td>
<td>25 - 60 km/h</td>
</tr>
<tr>
<td>Cyclist speed</td>
<td>15 km/h</td>
<td>15 km/h</td>
</tr>
<tr>
<td>Obstruction</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Impact point</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>AEB/FCW</td>
<td>AEB</td>
<td>AEB</td>
</tr>
</tbody>
</table>

![Bicyclist Diagram](image)

*Image: © 2017 Euro NCAP*
2018 AEB VRU

Other details

- Preconditions and HMI as 2016
- Lateral deviation of target during longitudinal tests: Max 0.15m
- In longitudinal tests – driver bail out at TTC < 1.5s

“For crossing scenarios the reference point of the EBT is the centre of the bottom bracket (crank shaft) (dashed line in Figure 5) and for the longitudinal scenario the most rearward point on the rear wheel is used.”
AEB VRU Comparison

2016

- Pedestrian
  - Runs: 38

- Ped Rig, 2 Robots, EPT x 2, 2 Obscuration vehicles

- 2 Days

2018

- Pedestrian
  - Runs: 54 (Day)
  - Cyclist
    - Runs: 25

- Ped Rig, 2 Robots, EPT x 2, EBT, 2 Obscuration vehicles, Obscuration Wall

- Estimate: 3 days, 1 night
What do we need

2018 Requirements

- Cyclist target: 4a
- VRU Surfboard: 4a, ABD, (DSD)
- Street lights?
2016 Lane Support Systems

- Lane Departure Warning (LDW)
- Lane Keep Assist (LKA)
- Driver and Passenger Sides
2018 Lane Support Systems

LSS Scenarios

- Lane Departure Warning (LDW)
- Lane Keep Assist (LKA)
- Emergency Lane Keep (ELK)

- ELK - Defined as a default-on system which intervenes only when threat detected: Collision or Road Departure

- Considerable overlap between ELK and LKA, for example, so some tests may not need to be duplicated
2018 Lane Support Systems

Emergency Lane Keep – Road Edge

• Tested 0.2 – 0.5m/s lateral velocity
• Passenger side only
• Manoeuvre as 2016 LKA
• Test hardest scenario first – if pass, automatically award points for easier scenarios.
• Pass criteria - <0.1m Road edge departure
2018 Lane Support Systems

- Emergency Lane Keep – Oncoming

- VuT and GVT both at 72km/h
- 0.3 – 0.6m/s lateral velocity
- Projected 10% overlap at impact
- Evasive steering if no intervention by 0.8s TTC
2018 Lane Support Systems

Emergency Lane Keep – Overtake

- GVT at 72km/h and 80km/h. VUT at 72km/h.
- Unintentional lane change – 0.3 - 0.6m/s Vlat
- Intentional lane change – 0.5 - 0.7m/s Vlat with turn signal activated and 800m radius
- Front of GVT level with VUT rear axle at impact.
- Bailout at <0.2m separation if no intervention.

Front of GVT in line with rear axle of VUT
2018 Lane Support Systems

- Lane Keep Assist

  - Additional Road Edge Scenario
    - Passenger Side only
    - Pass Criteria: <0.1m departure

  - Solid and dashed line
    - Both Sides of vehicle
    - Pass Criteria <0.3m departure

  - All tested 0.2 – 1m/s Vlat
  - Assessed 0.2 – 0.5m.s Vlat.

If Pass in left three scenarios, no need to perform right three
2018 Lane Support Systems

Lane Departure Warning

- Only performed if LDW can be selected to work stand alone
- If only available when LKA active, take data from LKA tests
- Solid and Dashed in both directions.
- Test 0.2 - 1m/s Vlat
- Assessed 0.2 - 0.5m/s Vlat
- Pass Criteria: LDW at <0.2m departure
LSS Comparison

2016
- Lane Keep Assist
  - 60 Runs
- Lane Departure Warning
  - 8 Runs
- 1 Robot, Lane markings
- 1 Day

2016
- Emergency Lane Keep
  - Road Edge: Estimate 20 Runs
  - Oncoming: Estimate 15 Runs
  - Overtake: Estimate 20 Runs
- Lane Keep Assist
  - Estimate 75 Runs
- Lane Departure Warning
  - Possible 18 Runs
- 1 Robot, Platform, GVT, Lane, Road Edge
- Estimate 1(?) Day
What do we need

2018 Requirements

- Currently no standardised definition of road edge
- Target and appropriate spares
2018 Speed Assistance Systems

- Speed limit information function
  - Implicit speed limits
  - Conditional speed limits

- Speed control function
  - Manual Speed Assistance
  - Intelligent Speed Assistance
  - Also allow Intelligent ACC (adapts ACC settings depending on local speed limit)
## OVERALL RATING SCHEME

### 2016 vs 2018 POINTS ALLOCATION

#### 2016

<table>
<thead>
<tr>
<th>AOP (40%)</th>
<th>COP (20%)</th>
<th>PP (20%)</th>
<th>SA (20%)</th>
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</thead>
<tbody>
<tr>
<td>8</td>
<td>Front ODB</td>
<td>24</td>
<td>Dynamic tests</td>
</tr>
<tr>
<td>8</td>
<td>Front FW</td>
<td>12</td>
<td>CRS installation</td>
</tr>
<tr>
<td>8</td>
<td>Side barrier</td>
<td>13</td>
<td>Vehicle based</td>
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<tr>
<td>8</td>
<td>Side pole</td>
<td></td>
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</tr>
<tr>
<td>3</td>
<td>AEB City</td>
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<td></td>
</tr>
<tr>
<td>3</td>
<td>Whiplash F/R</td>
<td></td>
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</tr>
<tr>
<td>38</td>
<td>Total available</td>
<td>49</td>
<td>Total available</td>
</tr>
</tbody>
</table>

#### 2018

<table>
<thead>
<tr>
<th>AOP (40%)</th>
<th>COP (20%)</th>
<th>PP (20%)</th>
<th>SA (20%)</th>
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<tbody>
<tr>
<td>8</td>
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<td>38</td>
<td>Total available</td>
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## OVERALL RATING SCHEME

### Star Rating Thresholds

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<td>75%</td>
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<td>For three stars, at least:</td>
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<td>15%</td>
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<td>For one star, at least:</td>
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<td>40%</td>
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<td>For one star, at least:</td>
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<td>40%</td>
<td>20%</td>
<td>30%</td>
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CONCLUSIONS

- Work ongoing also in passive safety
- Active safety has great potential
- Individual ADAS will form building blocks of automated driving
- 2020 – 2025 roadmap to include new ADAS technologies
- Euro NCAP will continue to ensure robust system performance
Thank you for your attention
FOR SAFER CARS
EURO NCAP
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Definition
Setting and coordinate system

Illuminance field based on example
Schuch LED-Leuchte 43 1603 ABX C

\[ E > 20 \text{lx} \]
\[ E_{\text{min}} > 15 \text{lx} \]
\[ E_{\text{min}} > 5 \text{lx} \]