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# **Proposal for a Modification of the Lower/Upper Legform to Bumper Test Area in GTR9-PH 2 and UN-R 127 01 Series of Amendments**

**6<sup>th</sup> Meeting of Task Force Bumper Test Area (TF-BTA)  
Paris, May 15<sup>th</sup>, 2014**

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# Background

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- **TF-BTA started in March 2012**
- **Focus: revision of the bumper test area to counteract manufacturer's practice of narrowing the bumper test area by any design means**
- **At the constitutional meeting of TF-BTA, the German Federal Ministry of Transport and Digital Infrastructure (BMVI) handed in a document from BAST, explaining about the history of the BTA definition and making an optional proposal for an alternative bumper test area:**

**Option 1:**

**Introduction of the test area according to Euro NCAP**

**Option 2:**

**Use of whole vehicle width**

# Current GTR9 Definitions

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## 7. TEST PROCEDURES

### 7.1. Legform to bumper test procedures

#### 7.1.1. Lower legform to bumper test procedure:

Each test shall be completed within two hours of when the impactor to be used is removed from the controlled storage area.

##### 7.1.1.1. The selected target points shall be in the bumper test area.

**[...]**

#### 7.1.2. Upper legform to bumper test procedure:

Each test shall be completed within two hours of when the impactor to be used is removed from the controlled storage area.

##### 7.1.2.1. The selected target points shall be in the bumper test area as defined in paragraph 3.10.

# Current GTR9 Definitions (cont'd)

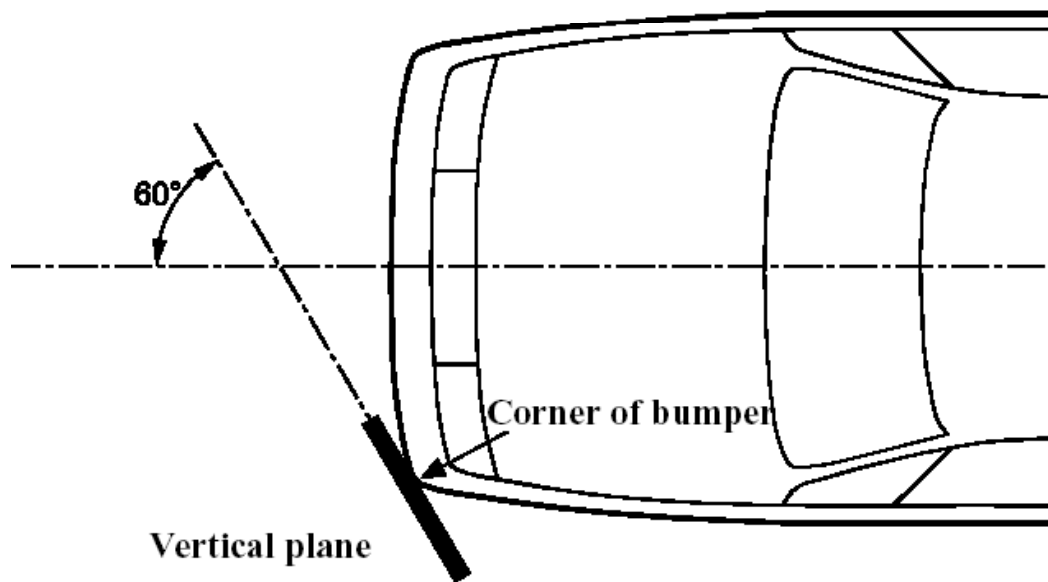


- 3.10. "Bumper test area" means the frontal surface of the bumper limited by two longitudinal vertical planes intersecting the corners of the bumper and moved 66 mm parallel and inboard of the corners of the bumpers.

[...]

- 3.13. "Corner of bumper" means the vehicle's point of contact with a vertical plane which makes an angle of  $60^\circ$  with the vertical longitudinal plane of the car and is tangential to the outer surface of the bumper (see Figure 5).

[...]



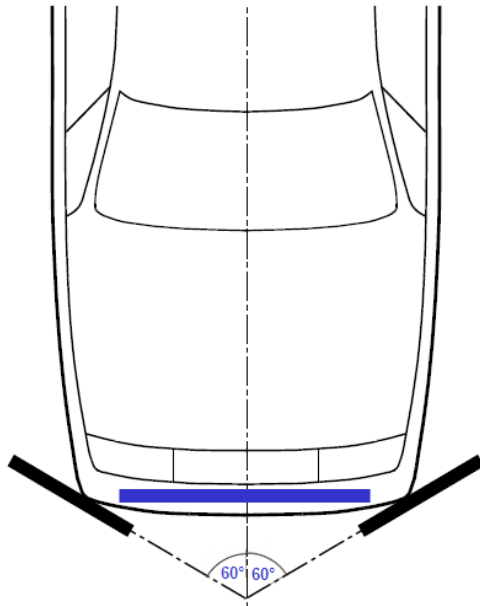
# BASt Option 1



## Option 1: Introduction of the test area according to Euro NCAP

*“The bumper test zone is defined as either the area limited by the bumper corners or the outermost ends of the bumper beam/lower rails/cross beam structures, whichever is larger.”*

→ **max** (bumper beam width, bumper corner area)





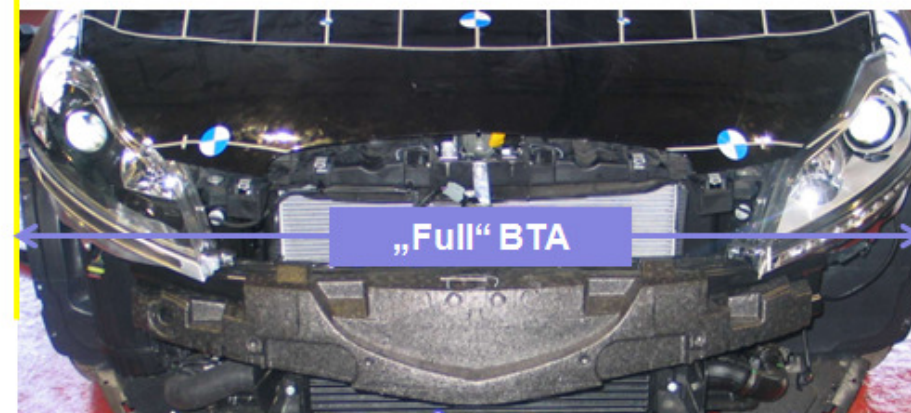
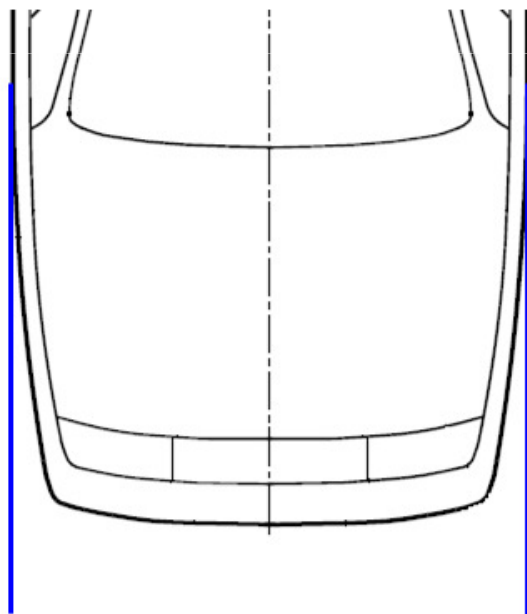
# BASt Option 2



## Option 2: Use of whole vehicle width

*Whole vehicle width,  
i.e. nominal width of the vehicle  
without mirrors (from technical  
datasheet)*

→ “Full” BTA



# BASt Option 2 (cont'd)



## Option 2: Justification

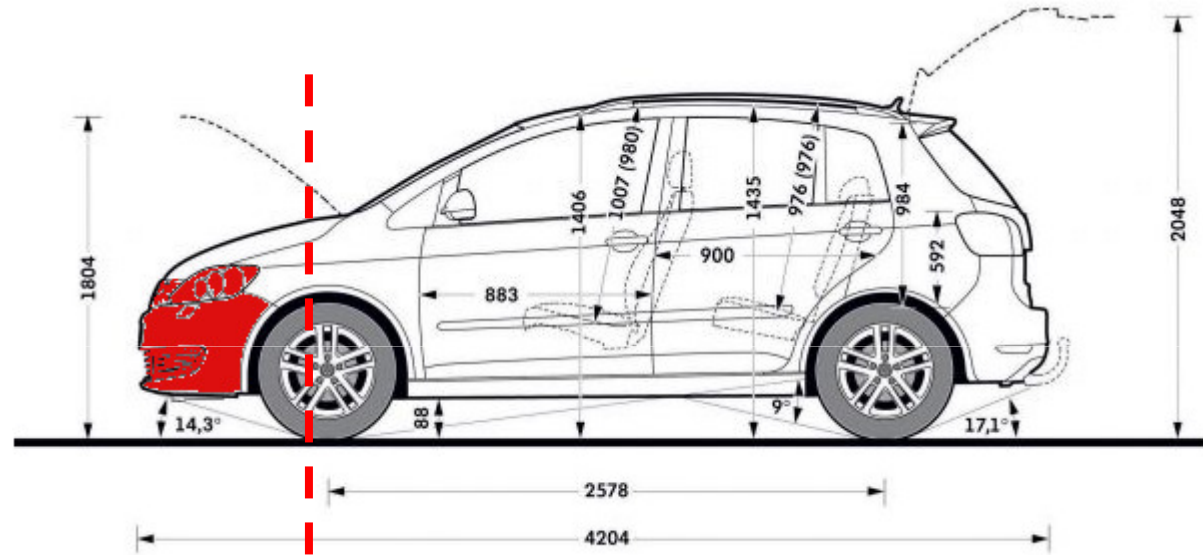
### Distribution of first pedestrian contact at passenger car front \*1)

#### Dataset:

GIDAS data 2000 – 2012

Vehicle to pedestrian accidents with one collision partner only

Passenger cars only



**Injury causing vehicle part: vehicle frontend only,  
i.e. bumper, grille, headlamps, front spoiler, license plate, indicators**

**Impact location between most forward vehicle part and 20 percent of total vehicle length rearward**

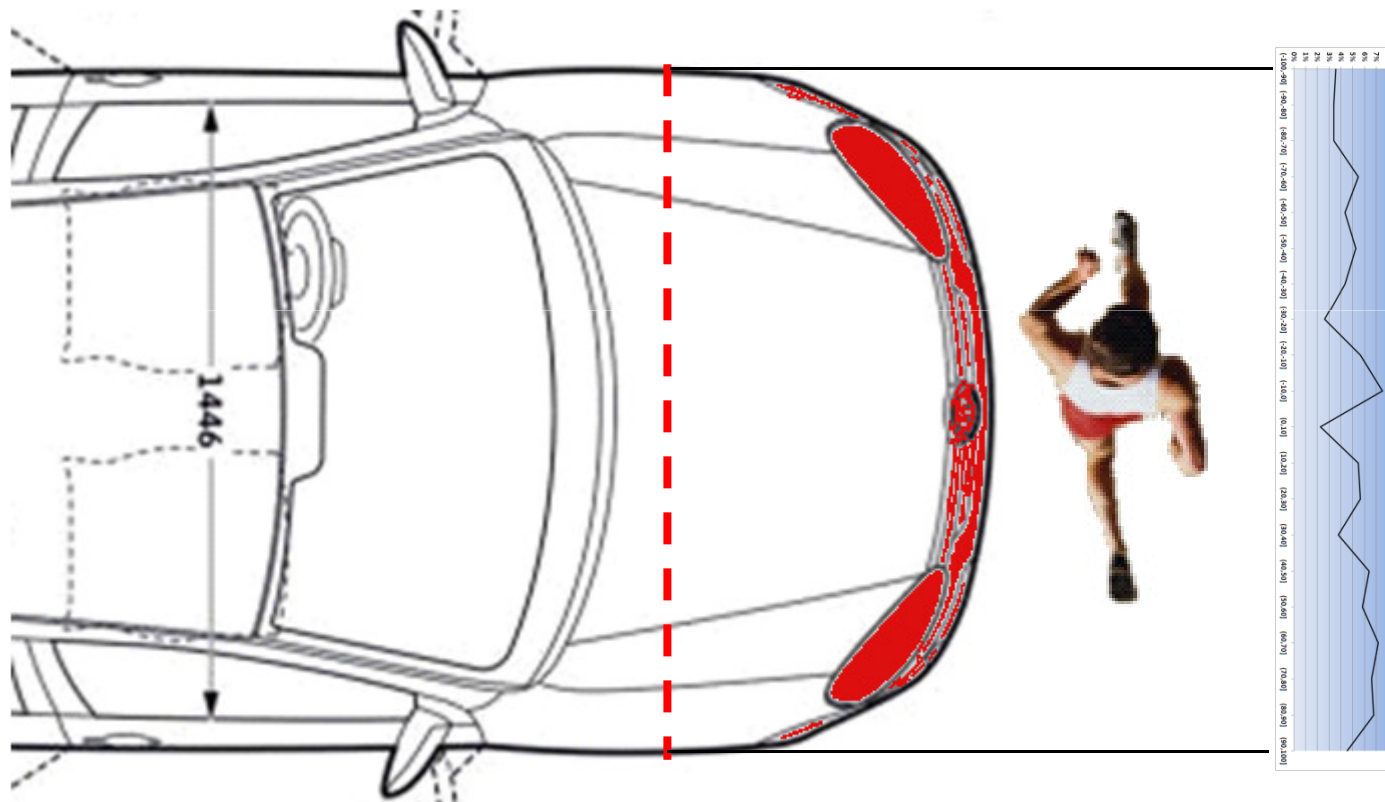
\*1): in crashes with at least one injury suffered from contact with a part of the vehicle frontend

# BASt Option 2 (cont'd)

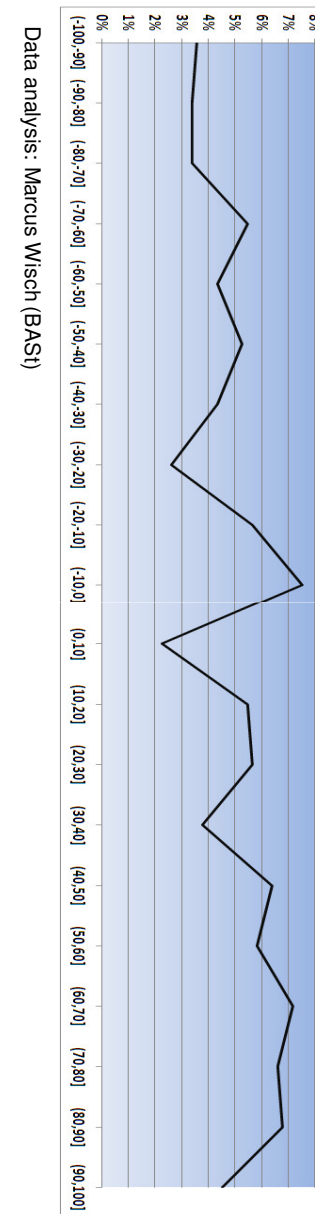


## Option 2: Justification

### Distribution of first pedestrian contact at passenger car front \*1)



**N=567**



\*1): in crashes with at least one injury suffered from contact with a part of the vehicle frontend

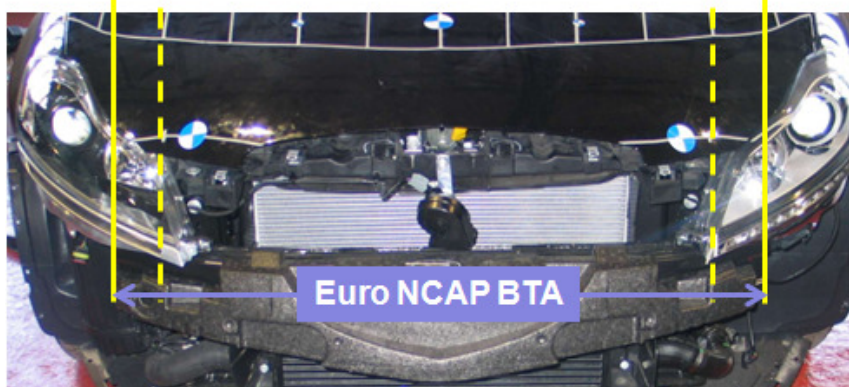


# TF-BTA Discussions



- During the course of the TF-BTA, several (further) proposals were discussed as possible future options:

## Option 1: Adoption of Euro NCAP procedure



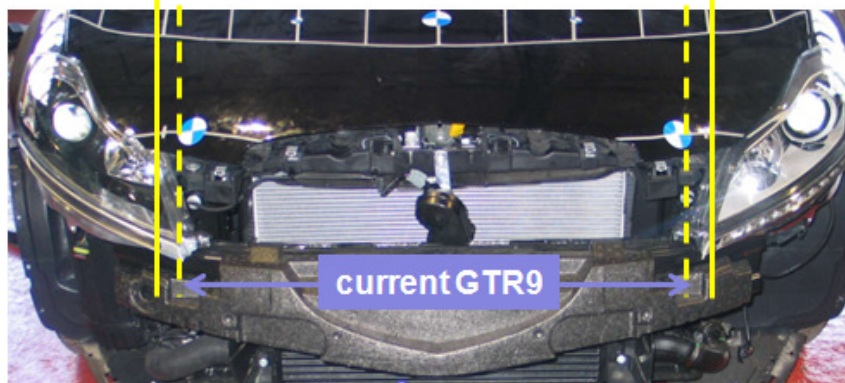
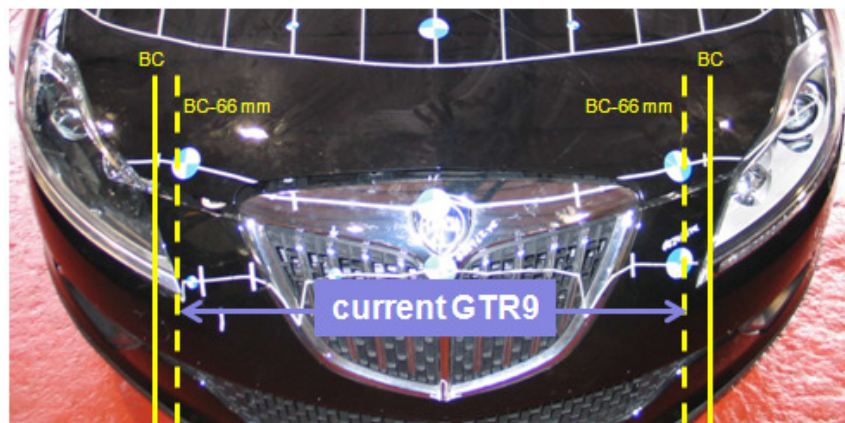
## Option 2: Extension to whole vehicle width



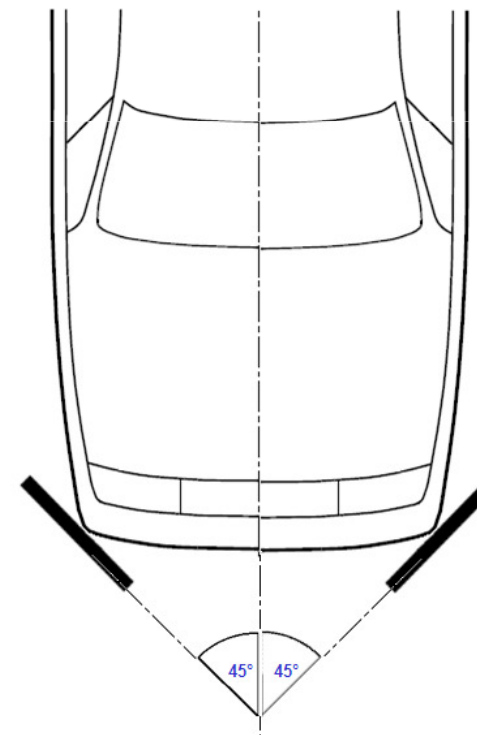
# TF-BTA Discussions (cont'd)



## Option 3: No changes



## Option 4: Extension to bumper corners defined by 45 degrees planes





# TF-BTA Discussions (cont'd)



## Option 5: Maximum of current bumper corner definition under consideration of US Bumper Standard 49 CFR Part 581 (406 – 508 mm)

(b) *Corner impact test procedure.* (1) Impact a front corner and a rear corner of the vehicle once each with the impact line at a height of 20 inches and impact the other front corner and the other rear corner once each with the impact line at any height from 16 to 20 inches, inclusive, in accordance with the following procedure.

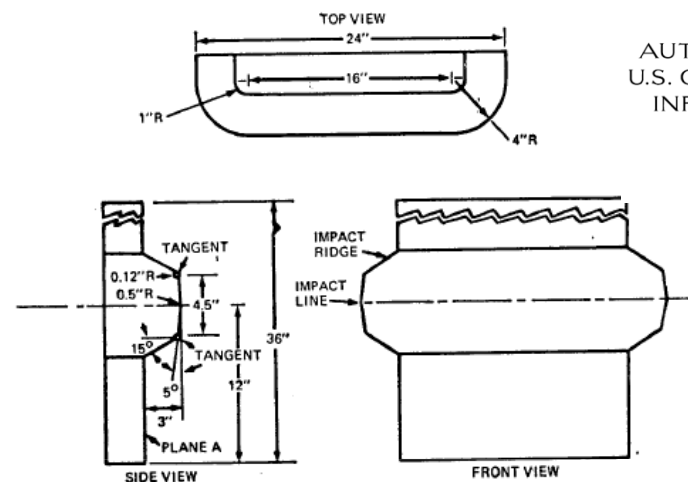
(2) For an impact at a height of 20 inches, place the test device shown in Figure 1 so that Plane A is vertical and the impact line is horizontal at the specified height.

(3) For an impact at a height between 16 inches and 20 inches, place the test device shown in Figure 2 so that Plane A is vertical and the impact line is horizontal at a height within the range.

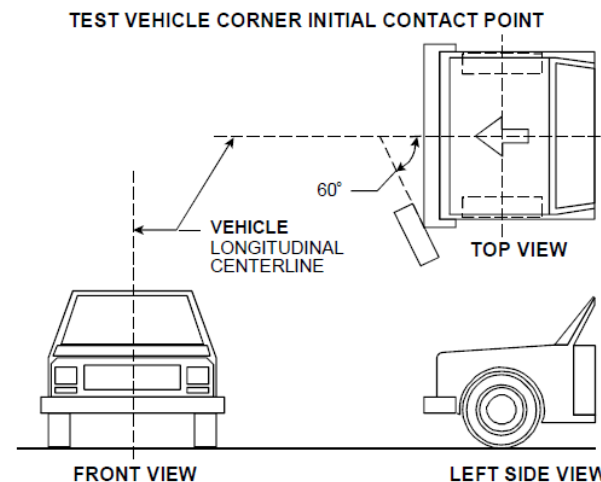
(4) Align the vehicle so that a vehicle corner touches, but does not move, the lateral center of the test device with Plane A of the test device forming an angle of 60 degrees with a vertical longitudinal plane.

(5) Move the test device away from the vehicle, then release it to impact the vehicle.

(6) Perform the impact at intervals of not less than 30 minutes.



Source: 49 CFR Part 581



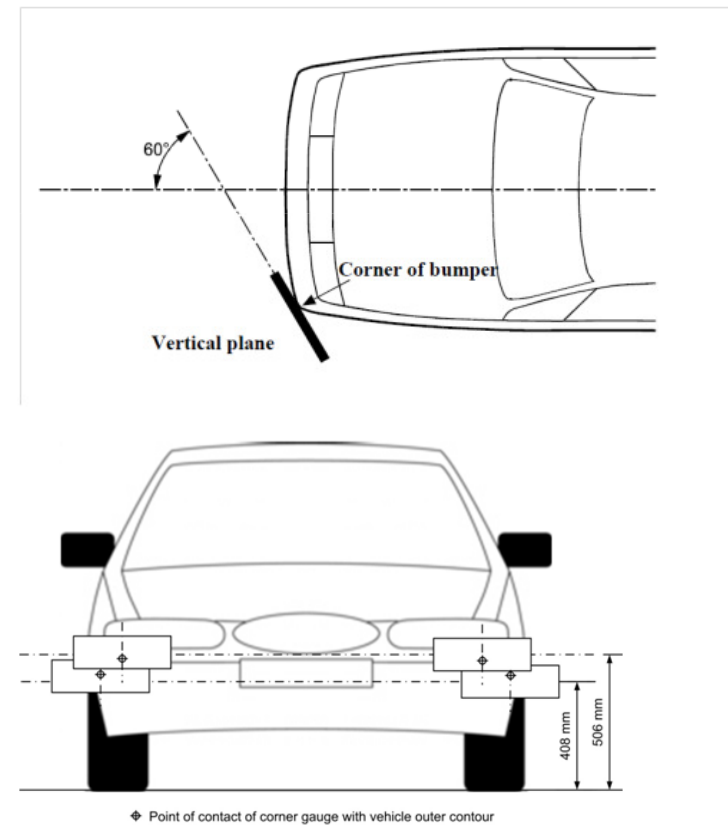
# TF-BTA Discussions (cont'd)



- In the end, two proposals are made by Industry and the European Commission:
- Proposal 1 (TF-BTA-6-03):

**Definition of the bumper corner by the outermost contact points defined by:**

- the vehicle's point of contact with a vertical plane making an angle of  $60^\circ$  with the vertical longitudinal vehicle plane (i.e. as before)**
- the outermost contact point defined by contacting the vehicle with the vertical centerline of a 610 mm \* 114 mm corner gauge at a height of the corner gauge's horizontal centerline at 408 mm and 506 mm above GL, whereas the gauge making an angle of  $60^\circ$  with the vertical longitudinal vehicle plane**



# TF-BTA Discussions (cont'd)



- Proposal 2 (TF-BTA-6-04):

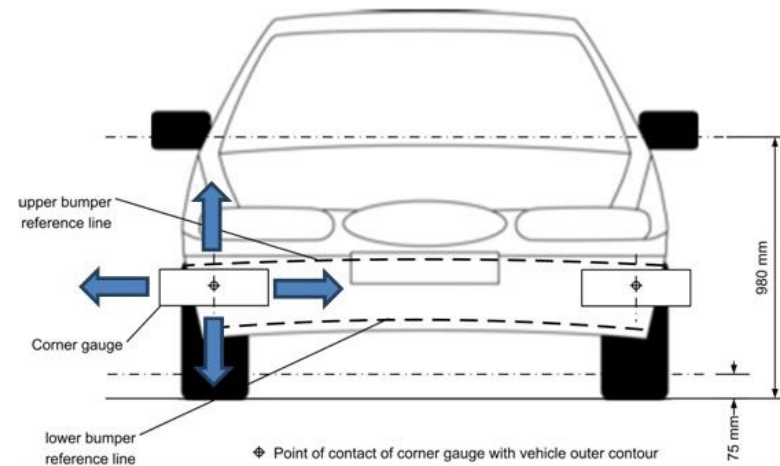
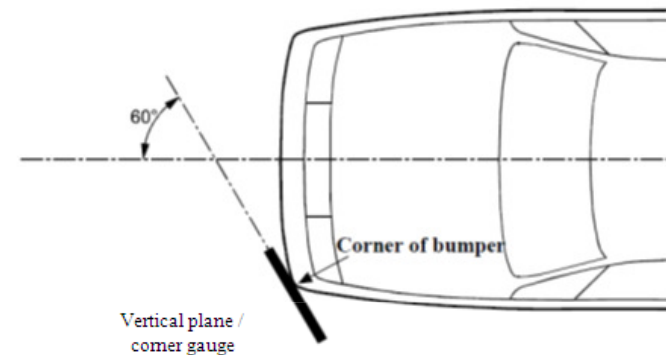
Definition of the bumper corner by the outermost contact points defined by:

contacting the vehicle with the vertical centerline of a 610 mm \* 114 mm corner gauge between

the height of the corner gauge's top edge at the maximum height of the UBRL, not exceeding 908 mm above GL

and the corner gauge's bottom edge at the minimum height of the LBRL, not going below 75 mm above GL,

whereas the gauge making an angle of 60° with the vertical longitudinal vehicle plane



# Analysis of Proposals



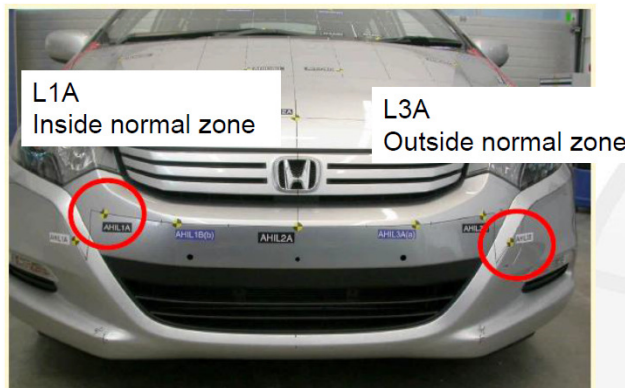
- While both proposals are adopting essential elements of the test area definition as described within the US Bumper Standard 49 CFR Part 581 / UN-R 42, BAST was and still is in favour of at least taking over the Euro NCAP procedure.
- Reasons:
  1. Injurious points have been continuously found outside the current test area, especially at the ends of the bumper beam.
  2. Proposal 2 (TF-BTA-6-04) does not work.
  3. The bumper definition according to the US Bumper Standard / Proposal 1 (TF-BTA-6-03) does not always cover the entire bumper beam.
  4. The bumper definition according to the US Bumper Standard / Proposal 1 (TF-BTA-6-03) remains not being robust against any vehicle (outer) design measures.
  5. When taking over the explicit RCAR definition of the bumper beam, the Euro NCAP procedure is robust also for legislation.
  6. The RCAR definition of a bumper beam is widely accepted.



# Analysis of Proposals (cont'd)



1. Injurious points have been continuously found outside the current test area:



LEGFORM		L1		L3	
Tibia acceleration - g	104	1.00	329	0.00	
Knee shear displacement - mm	2.5	1.00	7.5	1.00	
Knee bending angle - deg	7.8	1.00	22.1	0.00	
Legform assessment	1.00		0.00		

L1A  
Limit of normal zone

S2  
Inside bumper corner

S1  
Outside bumper corner



LEGFORM		L1		S1		S2	
Tibia acceleration - g	91	1.00	363	0.00	164	0.71	
Knee shear displacement - mm	2.0	1.00	3.5	1.00	3.4	1.00	
Knee bending angle - deg	9.8	1.00	25.5	0.00	14.8	1.00	
Legform assessment	1.00		0.00		0.71		



# Analysis of Proposals (cont'd)



## 2. Proposal 2 (TF-BTA-6-04) does not work:

As the lateral limitations of the upper (and lower) bumper reference lines as defined in sections 3.27 and 3.21 of UN-GTR 9 are implied by the bumper corners, latter ones cannot be defined by any means like maximum (minimum) values of the mentioned references lines.



Maximum of UBRL ?

Minimum of LBRL ?

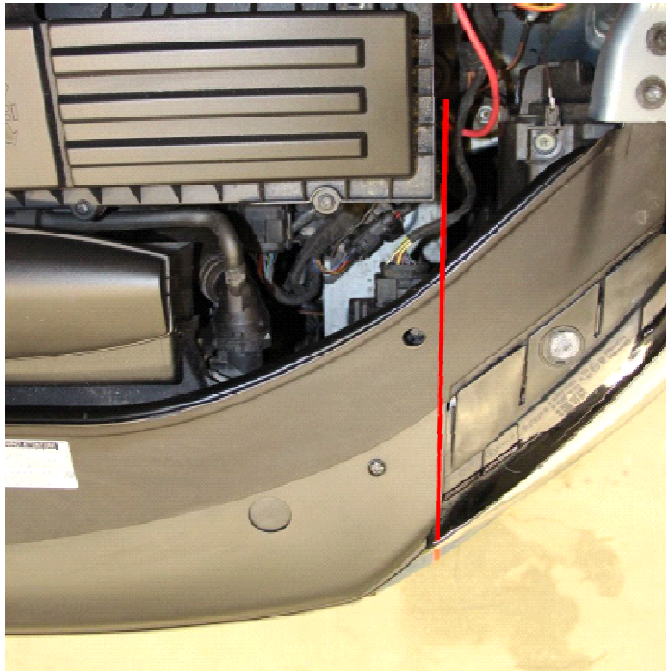
# Analysis of Proposals (cont'd)



## 3. The bumper definition according to the US Bumper Standard / Proposal 1 (TF-BTA-6-03) does not always cover the entire bumper beam:

Example for a current high-volume vehicle having a bumper beam exceeding the proposed limits

End of bumper beam (= end of longitudinal member)



(red line indicating position of longitudinal member)

Mark-up according to proposal 1: 30° w/ corner gauge



**Difference between bumper beam width and proposed impact zone width:  
approx. 140 mm**



# Analysis of Proposals (cont'd)



3. The bumper definition according to the US Bumper Standard / Proposal 1 (TF-BTA-6-03) does not always cover the entire bumper beam:



EOBB

BC (TF-BTA-6-03)

# Analysis of Proposals (cont'd)



3. The bumper definition according to the US Bumper Standard / Proposal 1 (TF-BTA-6-03) does not always cover the entire bumper beam:

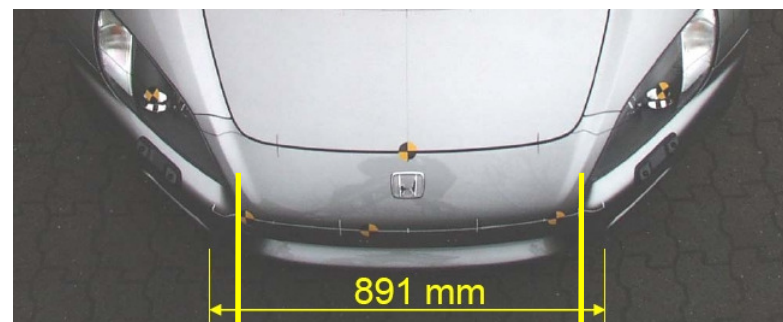
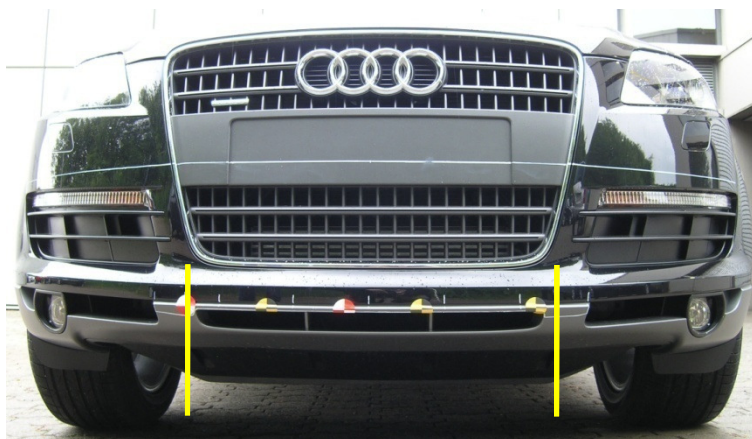




# Analysis of Proposals (cont'd)



4. The bumper definition according to the US Bumper Standard / Proposal 1 remains not being robust against any vehicle (outer) design measures:





# Analysis of Proposals (cont'd)

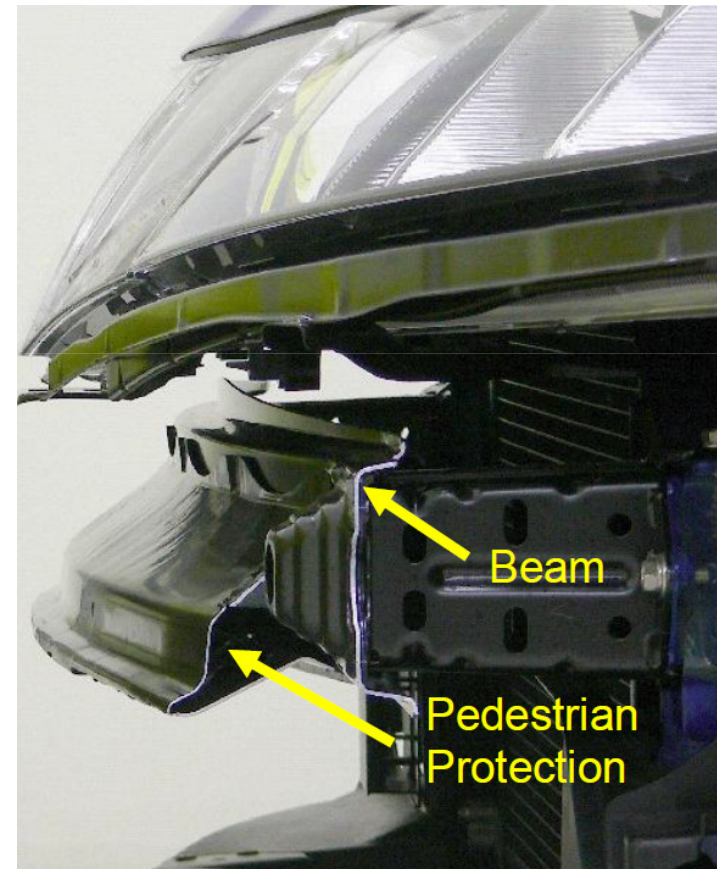


5. When taking over the explicit RCAR definition of a bumper beam, the Euro NCAP procedure is robust also for legislation:

Bumper Beam  
(RCAR definition):  **RCAR**

“Structural cross member under the bumper fascia protecting the front or rear of the vehicle.

(Note: The beam does not include foam, cover support or pedestrian protection devices, see 5.1.5).”



Source: RCAR Bumper Test 2.0

# Analysis of Proposals (cont'd)



## 6. The RCAR definition of a bumper beam is widely accepted, as can be seen by the members of RCAR:



### North America

CESVI Mexico (Mexico) - Member since 1998  
 Insurance Corporation of B.C. (Canada) - Member since 1988  
[Insurance Institute for Highway Safety \(IIHS\), Vehicle Research Center \(USA\)](#) - Member since 1997  
 Manitoba Public Insurance (Canada) - Member since 1991  
 State Farm Research (USA) - Member since 1995  
 Tech-Cor Inc. (USA) - Member since 1983

### Asia Region

IAG Research Centre (Australia) - Member since 1981  
 The Jiken Center (Japan) - Member since 1978  
 KART (Korea) - Member since 1994  
 Samsung Fire & Marine Insurance, Automotive Research Institute (Korea) - Member since 2010  
 MRC (Malaysia) - Member since 2004

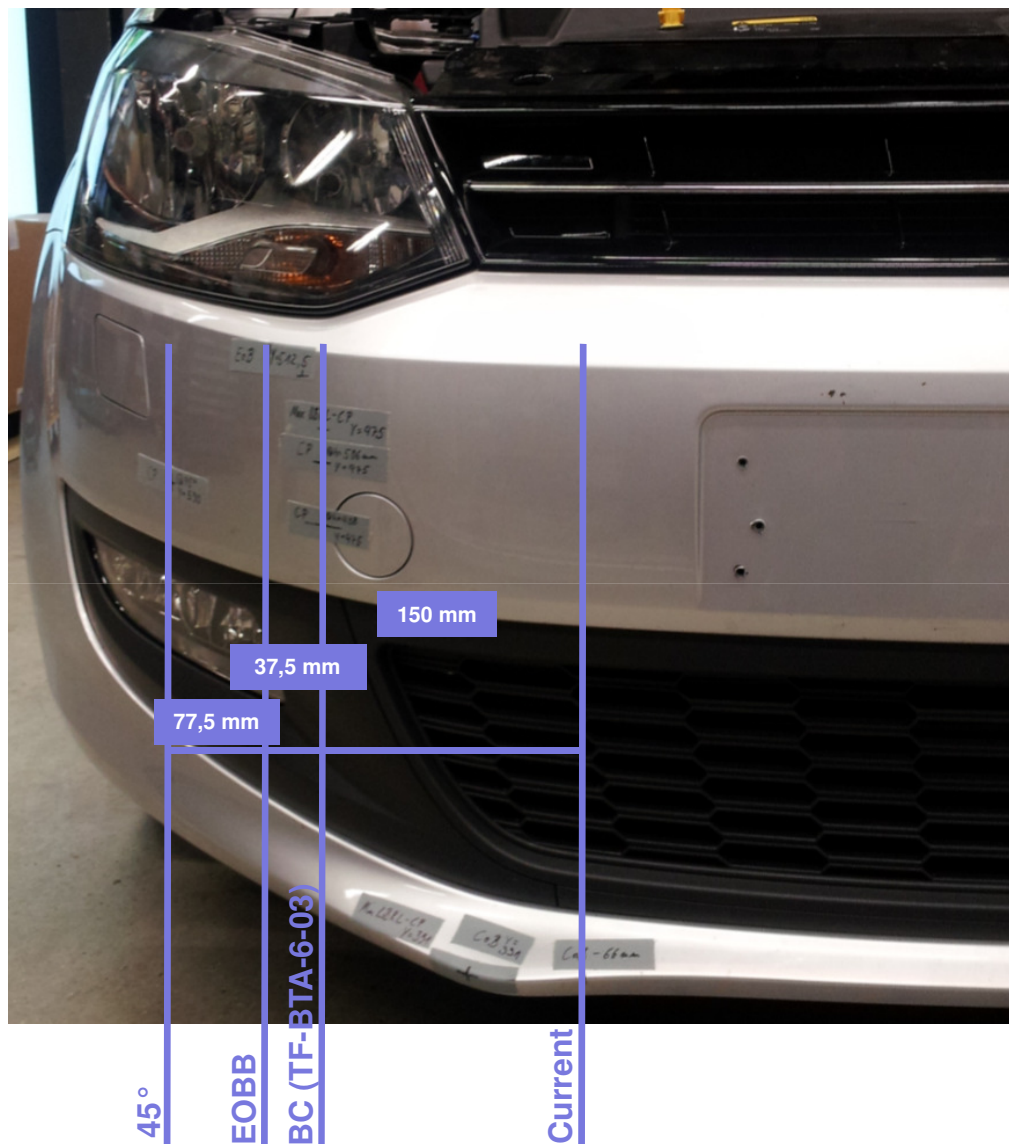
### Europe

[AZT Automotive GmbH \(Germany\)](#) - Member since 1972  
 AXA Winterthur (Switzerland) - Member since 2005  
 Bilskadekomiteen (Norway) - Member since 1972  
 CENTRO ZARAGOZA (Spain) - Member since 1990  
 CESVIMAP (Spain) - Member since 1985  
 CESVI France (France) - Member since 1999  
 Folksam Auto AB (Sweden) - Member since 1972  
 GENERALICAR (Italy) - Member since 1986  
 KTI (Germany) - Member since 1990  
[THATCHAM \(UK\)](#) - Member since 1972  
 LVK (Finland) - Member since 1974

### South America

CESVI Argentina (Argentina) - Member since 1996  
 CESVI Brasil S/A (Brazil) - Member since 1996  
 CESVI Colombia (Colombia) - Member since 2000

# Comparison of Test Areas



# Conclusions

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- 1. In depth accident data gives evidence of an equal distribution of first pedestrian contact at the front of passenger cars in crashes with at least one injury suffered from contact with a part of the vehicle frontend.**
- 2. Thus, the assessment of injury risks for vulnerable road users should be basically done considering the entire vehicle width.**
- 3. However, if a limitation of the test area seems necessary due to feasibility reasons for whatever nature, at least no potentially injurious structures should be prematurely excluded from the test area.**

# Conclusions (cont'd)

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4. **Injurious points have been continuously found outside test areas defined by measurements depending on the outer contour, especially at the ends of the bumper beam.**
5. **Therefore, at least the entire bumper beam should be included within the test area.**
6. **Procedures based on the outer vehicle contour do not necessarily include the relevant injurious vehicle structures (bumper beam).**
7. **There is no evidence for the RCAR definition of the bumper beam not being robust also for legislation.**





**3.10 The bumper test area is defined as either the area limited by the bumper corners or the outermost ends of the bumper beam/lower rails/cross beam structures, whichever is larger.**

**3.13 The corner of bumper is the point of contact of the vehicle with a vertical plane which makes an angle of  $60^\circ$  with the vertical longitudinal plane of the car and is tangential to the outer surface of the bumper, see Figure 5. Where multiple or continuous contacts occur the most outboard contact shall form the bumper corner.**

**3.30 The bumper beam is defined as the structural cross member under the bumper fascia protecting the front of the vehicle. The beam does not include foam, cover support or any pedestrian protection devices.**





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**Thank you !**

**Questions ?**