Status of Research Work of EEVC WG 15

„Compatibility Between Cars“

Eberhard Faerber on behalf of EEVC WG 15

38th WP.29/GRSP Geneva, 06 - 09 December 2005
The Terms of Reference of EEVC WG 15

are to develop a test procedure to assess car frontal impact compatibility and establish criteria to rate frontal impact compatibility. The Working Group will report its findings and will propose a test procedure in November 2006.

The full version of the terms of reference can be found on the Web-site of EEVC WG 15
## Actual membership of EEVC WG 15:

<table>
<thead>
<tr>
<th>Member</th>
<th>Industry advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eberhard Faerber, BAST (chairman)</td>
<td>Dr. Robert Zobel/VW</td>
</tr>
<tr>
<td>Tiphaine Martin, UTAC (secretary)</td>
<td>Richard Zeituni/PSA Peugeot Citroen</td>
</tr>
<tr>
<td>Pascal Delannoy/UTAC (substitute)</td>
<td></td>
</tr>
<tr>
<td>Giancarlo Della Valle/Elasis</td>
<td>Federico Pasqui/Fiat</td>
</tr>
<tr>
<td>Jaoquim Huguet/IDIADA</td>
<td></td>
</tr>
<tr>
<td>Cor van der Zweep/TNO</td>
<td></td>
</tr>
<tr>
<td>Dr. Mervin Edwards/TRL</td>
<td>Martin Harvey/Jaguar</td>
</tr>
<tr>
<td>Robert Thomson/Chalmers University</td>
<td>Anders Kling/Volvo</td>
</tr>
</tbody>
</table>

**Observer**

None (invited David L. Smith/NHTSA)
Current Main topic at the moment: Give advice to and guide the VC COMPAT project commenced in March 2003 for a period of 3,5 years. The project is funded by the EU-Commission.

Objective of the VC COMPAT Project: To draft legal test procedures to assess
  • car to car crash compatibility
  • (EEVC WG 14: car to truck Compatibility)
<table>
<thead>
<tr>
<th>Workplan</th>
</tr>
</thead>
<tbody>
<tr>
<td>WP 1: Structure Analysis - UTAC</td>
</tr>
<tr>
<td>Car Fleet - UTAC</td>
</tr>
<tr>
<td>WP 2: Accident Analysis &amp; Cost-Benefit Analysis - BAsT</td>
</tr>
<tr>
<td>Car to Car Impact - BAsT</td>
</tr>
<tr>
<td>WP 3: Crash Testing &amp; Analysis - TRL</td>
</tr>
<tr>
<td>WP 4: Car to Car &amp; Car to Barrier Crash Modelling - TNO</td>
</tr>
<tr>
<td>WP 5: Synthesis of Test Procedure for Car to Car Impact - TRL</td>
</tr>
<tr>
<td>WP 10: Industrial Liaison and Dissemination - TNO</td>
</tr>
<tr>
<td>Car to Car Impact - ChUT</td>
</tr>
<tr>
<td>WP 11: Project Management - TRL</td>
</tr>
<tr>
<td>Car to Car Impact - TRL</td>
</tr>
</tbody>
</table>

EEVC WG 15, Compatibility Between Cars
Status December 2005:

- WP 1: Structure analysis (UTAC) completed
- WP 2: Accident Analysis, Cost Benefit Analysis (BASt, TRL)
  - Accident Analysis, Benefit Analysis (TRL, BASt) completed
  - Cost Analysis (Fiat) to be done
- WP 3: Crash Testing Test Programme (BAST, Fiat, TRL, UTAC) completed
- WP 4: Fleet Modelling (TNO) drafted
- WP 5: Synthesis (TRL, all) to be done 01/2006 to 09/2006
OBJECTIVES:

- The objective of WP1 is to measure and create a database containing dimensions of the main car and truck/trailer structures that are involved in front and side collisions.

- This database will be used to study current car-to-car and car-to-truck geometric incompatibility.
Structure Analysis

### CAR SELECTION:

<table>
<thead>
<tr>
<th></th>
<th>A segment</th>
<th>B segment</th>
<th>C segment</th>
<th>D segment</th>
<th>D/E segment</th>
</tr>
</thead>
<tbody>
<tr>
<td>n°</td>
<td>name</td>
<td>%</td>
<td>n°</td>
<td>name</td>
<td>%</td>
</tr>
<tr>
<td>1</td>
<td>Citroën C2</td>
<td>0.21</td>
<td>6</td>
<td>Citroën C3</td>
<td>1.85</td>
</tr>
<tr>
<td>2</td>
<td>Renault Twingo</td>
<td>0.7</td>
<td>7</td>
<td>Opel Corsa</td>
<td>2.6</td>
</tr>
<tr>
<td>3</td>
<td>Smart</td>
<td>0.07</td>
<td>8</td>
<td>Renault Clio</td>
<td>3.11</td>
</tr>
<tr>
<td>4</td>
<td>Toyota Yaris</td>
<td>1.32</td>
<td>9</td>
<td>VW Polo</td>
<td>2.12</td>
</tr>
<tr>
<td>5</td>
<td>Citroën Saxo</td>
<td>0.44</td>
<td>10</td>
<td>Peugeot 206</td>
<td>3.53</td>
</tr>
<tr>
<td></td>
<td>Fiat Punto</td>
<td>2.32</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ford Fiesta</td>
<td>2.5</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Seat Ibiza</td>
<td>1.14</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mercedes Aclass</td>
<td>0.9</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fiat Stilo</td>
<td>0.96</td>
<td>24</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### F segment

<table>
<thead>
<tr>
<th></th>
<th>Small MPV</th>
<th>MPV</th>
<th>4WD</th>
<th>LCV</th>
</tr>
</thead>
<tbody>
<tr>
<td>n°</td>
<td>name</td>
<td>%</td>
<td>n°</td>
<td>name</td>
</tr>
<tr>
<td>37</td>
<td>BMW 7series</td>
<td>0.09</td>
<td>40</td>
<td>Opel Meriva</td>
</tr>
<tr>
<td>38</td>
<td>Mercedes S class</td>
<td>0.11</td>
<td>41</td>
<td>Citroën Picasso</td>
</tr>
<tr>
<td>39</td>
<td>VW Phaeton</td>
<td>0.02</td>
<td>42</td>
<td>Opel Zafira</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>43</td>
<td>Renault Scenic</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>44</td>
<td>VW Touran</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>45</td>
<td>Renault Kangoo</td>
</tr>
</tbody>
</table>

⇒ 55 vehicles measured: representative of 61% of European sales in 2003
Structure Analysis

SYNTHESIS:

- Min
- Max
- Mean Height
- Weighted mean height
- Weighted mean delta

Part 581: 406 – 508 mm
FUP (laden): 306 – 441 mm

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38th GRSP, Dec. 06 - 09, 2005
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CONCLUSIONS:

• The purpose of this WP1 is to give information about the main car structures that are involved in front and side collisions
• (Structure Data were used to select car models to be tested)
• 55 vehicles were measured in this survey
• Data representative from 61% of the European sales in 2003
• The investigation area of frontal structure interaction may be positioned at 180 mm from the ground to 650 mm.
Benefit Analysis

Benefit Analysis to be carried out by TRL and BASt

Database

- **UK: CCIS**
  UK in-depth Co-operative Crash Injury Study
detailed and accurate information, including AIS codes
  crashes from June 1998 – present

- **UK: STATS19**
  UK national accident database
  includes all injury accidents that are reported by or to the police
  broad in scope, limited detail

- **Germany: GIDAS**
  German in Depth Accident Study
  representative for Germany

- **Germany: German national traffic accident data**
  similar to UK data
Benefit Analysis

Databases for UK and Germany are different:

UK:
- tow away accidents
- more severe accidents
- mostly retrospective analysis

Germany:
- analysis on the spot
- representative for Germany

Consequences:
- UK data contains more severe accidents
- German data contains only few very severe accidents
- different approaches
Benefit Analysis

Target Population for GB

- **Definition**
  - Casualties likely to experience reduced risk of injury as a result of improved compatibility

- **Methodology**
  - Select accidents where improved compatibility likely to help injury outcome
  - Count front seat occupant casualties

<table>
<thead>
<tr>
<th>Selection Criterion</th>
<th>Lower Estimate</th>
<th>Upper Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact location</td>
<td>frontal</td>
<td>frontal</td>
</tr>
<tr>
<td>Seat belt usage</td>
<td>only belted occupants</td>
<td>only belted occupants</td>
</tr>
<tr>
<td>Occupant position</td>
<td>only frontal occupants</td>
<td>only frontal occupants</td>
</tr>
<tr>
<td>Overlap</td>
<td>&gt; 30 %</td>
<td>&gt; 20 %</td>
</tr>
<tr>
<td>PDOF</td>
<td>11..1 o'clock</td>
<td>10..2 o'clock</td>
</tr>
<tr>
<td>ETS</td>
<td>all accidents up to 48 km/h</td>
<td>all accidents up to 56 km/h</td>
</tr>
</tbody>
</table>

- **Target population estimate**
  - 20% (343) to 31% (543) fatally injured car occupants
  - 41% (8,130) and 52% (10,504) seriously injured car occupants
Benefit Methodology - assumptions for GB

Aim of compatibility
– Predictable performance to absorb impact energy in frontal structure
– Little compartment intrusion
– Optimum deceleration pulse

Assumptions
• Pessimistic (lower)
  – Eliminate injuries caused by contact with an intruding front interior structure if ETS < 56 km/h
• Optimistic (upper)
  – Eliminate injuries caused by contact with the front interior (with or without intrusion) if ETS < 56 km/h
Results - Estimated Proportional Benefit for GB

- Pessimistic (lower)
  - Save 12% of fatalities & 9% of seriously injured casualties

- Optimistic (upper)
  - Save 25% of fatalities & 18% of seriously injured casualties
Benefit Analysis

Results – Estimated Benefit for GB

- **STATS19 (1999 - 2003) - adjust to remove cars registered before 1996**
  - Occupants in frontal impacts seated in front of car
    - 898 killed on average per year
    - 10,056 seriously injured on average per year
- **Pessimistic Estimate (Preventing Intrusion Injuries)**
  - Save 108 fatalities per year
  - Save 905 serious casualties per year
- **Optimistic Estimate (Preventing Contact Injuries)**
  - Save 225 fatalities per year
  - Save 1,810 serious casualties per year

Full paper: medwards@trl.co.uk
Benefit Analysis

Flowchart of the analysis

Step 1: Target Population

Step 2: Inj. Risk Analysis I

Step 3: Inj. Risk Analysis II

Risk Reduction => BENEFIT

Which accidents can be addressed?

What is the exact effect of improved compatibility and what effect will this have on the injury risk?

Accident Data (National, GIDAS-Data)
Benefit Analysis

STEP 1: Estimation of Target Population

Fatal car occupants in 2003

Seriously injured car occupants in 2003

Assumption:
Compatibility improves

- Single Car
- Car to Car
- Car to Truck

No improvement in multiple vehicle collisions

Compatibility can address 84% of all fatal and 85% of all serious accidents
### Benefit Analysis

**STEP 1: Estimation of Target Population**

<table>
<thead>
<tr>
<th></th>
<th>Car to Car Category</th>
<th>Car to Truck Category</th>
<th>Single Car Category</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Proportion</strong> of fatal Occ.</td>
<td>24%</td>
<td>15%</td>
<td>45%</td>
<td>84%</td>
</tr>
<tr>
<td><strong>Proportion</strong> of serious Occ.</td>
<td>40%</td>
<td>8%</td>
<td>37%</td>
<td>85%</td>
</tr>
<tr>
<td><strong>Share of frontal impacts</strong> Compatibility Relevant Accidents</td>
<td>60%</td>
<td>58%</td>
<td>51%</td>
<td>---</td>
</tr>
<tr>
<td><strong>Proportion</strong></td>
<td>68%</td>
<td>50%</td>
<td>20%</td>
<td>---</td>
</tr>
<tr>
<td><strong>TARGET P.</strong> Fatalities</td>
<td>9%</td>
<td>4%</td>
<td>5%</td>
<td>18%</td>
</tr>
<tr>
<td><strong>TARGET P.</strong> Serious Inj.</td>
<td>16%</td>
<td>2%</td>
<td>4%</td>
<td>22%</td>
</tr>
</tbody>
</table>

Target Population = „Proportion“ x „Share of frontal impacts“ x „Relevant Accidents“
STEP 2: Injury Risk Curves (Binary Data)

Probability: “serious or fatal occupant”

- Occupants are most likely to be not seriously and not fatally injured
- Occupants are most likely to be seriously or fatally injured

θ = 43kph

Predictor: EES / kph
STEP 2: Compatibility effect on injury risk

**ECE R.94, Euro NCAP:**
Assumption: Offset block fully compatible
Vehicle: 1500kg, $\Delta v = 64\text{km/h}$, 5 stars
$E_{\text{kin}} = 240\text{kJ}$, $E_{\text{def. Elem.}} = 35\text{kJ}$, $E_{\text{Vehicle R94}} = 205\text{kJ}$

**Car to Car Impact:**
Assumption: Start of compartment collapse at 50 - 56km/h
Vehicle = 1500kg, $\Delta v = 53\text{km/h}$, $E_{\text{Vehicle c2c}} = 160\text{kJ}$

Cars can absorb more energy showing similar deformation depth
- $\Delta E = 45\text{kJ}$ or
- $\Delta E/E = 28\%$ higher energy-absorption!
STEP 2: Injury Risk Estimation

Old and New Risk Curves for Frontal Passengers

- Old risk curve
- New risk curve

Δ EES

Probability vs. EES / kph
## STEP 3: BENEFIT Estimation

<table>
<thead>
<tr>
<th>Proportion of</th>
<th>Old Risk Curve</th>
<th>New Risk Curve</th>
<th>CHANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatalities</td>
<td>0.81%</td>
<td>0.45%</td>
<td>45%</td>
</tr>
<tr>
<td>Seriously Inj.</td>
<td>13.77%</td>
<td>11.21%</td>
<td>19%</td>
</tr>
<tr>
<td>Slightly Inj.</td>
<td>43.40%</td>
<td>43.81%</td>
<td>-1%</td>
</tr>
<tr>
<td>Uninjured</td>
<td>42.00%</td>
<td>44.52%</td>
<td>-6%</td>
</tr>
</tbody>
</table>

### Target P.

<table>
<thead>
<tr>
<th>Category</th>
<th>Car to Car</th>
<th>Car to Truck</th>
<th>Single Car</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal Occ.</td>
<td>9%</td>
<td>4%</td>
<td>5%</td>
<td>18%</td>
</tr>
<tr>
<td>Serious Occ.</td>
<td>16%</td>
<td>2%</td>
<td>4%</td>
<td>22%</td>
</tr>
</tbody>
</table>

### CHANGE

<table>
<thead>
<tr>
<th>Category</th>
<th>Car to Car</th>
<th>Car to Truck</th>
<th>Single Car</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal Occ.</td>
<td>45%</td>
<td>45%</td>
<td>45%</td>
<td>---</td>
</tr>
<tr>
<td>Serious Occ.</td>
<td>19%</td>
<td>19%</td>
<td>19%</td>
<td>---</td>
</tr>
</tbody>
</table>

### BENEFIT

<table>
<thead>
<tr>
<th>Category</th>
<th>Car to Car</th>
<th>Car to Truck</th>
<th>Single Car</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatal Occ.</td>
<td>4%</td>
<td>2%</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>Serious Occ.</td>
<td>3%</td>
<td>0.5%</td>
<td>0.7%</td>
<td>4.2%</td>
</tr>
</tbody>
</table>
Conclusion …

- 8 % of all fatal car occupants will take advantage of compatible frontal car structures
- 4.2 % of all seriously injured car occupants will benefit from compatible frontal car structures
- Socio-Economic saves of 500 M€ per anno can be expected.

(full paper: pastor@bast.de or faerber@bast.de)
Two favourite test procedure candidates:

• **Full Width Test** with high resolution load cell wall
• **Offset Deformable Barrier Test** with progressive deformable barrier and load cell wall

Other considered test procedures:

• ODB with standard deformable barrier
• Overload test
• Offset mobile deformable barrier (OMDB)
Crash Test Programme

Full Width Barrier With Deformable Element and Load Cell Wall
Crash Test Programme

Full Width Test With Deformable Element

Pre and post test front view, Resultant barrier deformation
Crash Test Programme

Full Width Test With Deformable Element

Maximum Force Distribution Behind Deformable Element

150mm 0.34MPa & 150mm 1.71MPa
Crash Test Programme

Full Width Barrier Evaluation

HOMOGENITY ASSESSMENT

- Cell homogeneity
  - Overall force distribution
- Row homogeneity
  - Vertical force distribution
- Column homogeneity
  - Horizontal force distribution
Full Width Barrier Evaluation

**Cell Homogeneity**

\[ V_c = \frac{\sum_{i=1}^{n_c} (L - f_i)^2}{n_c} \]

- \( V_c \) = Cell homogeneity assessment
- \( L \) = Target load level
- \( f \) = Peak cell force
- \( n_c \) = Number of cells in the smoothed footprint

- Indicates the overall force distribution

**Crash Test Programme**

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*Under Revision*
PDB Approach
(Progressive Deformable Barrier)

Crash Test Programme

EEVC WG 15, Compatibility Between Cars
PDB TEST PROCEDURE : CONFIGURATION

French proposal: update current R94 Frontal ODB test

3 parameters are changed:

• **OBSTACLE** : PDB Barrier
  ➢ To avoid bottoming out, more stable

• **SPEED** : 60 km/h
  ➢ to check compartment strength

• **OVERLAP** : 50%
  ➢ To check half width and be close to car to car test

⇒ More realistic test configuration
PDB TEST PROCEDURE : PDB BARRIER

⇒ PDB looks like a car
PDB TEST PROCEDURE: TOOLS AND MEASUREMENT

Tools

- Barrier
- LCW
- Vehicle

Measurements

- Deformation
- Force Deflection
- Intrusions + Dummy

Assessments (First step)

- AHOD: Average Height of Deformation
- ADOD: Average Depth of Deformation
- Homogeneity
- Force level
- Dummy criteria
- Intrusion level
PDB TEST PROCEDURE: CONCLUSIONS

Proposal:

Replace the current barrier by PDB one to update R94 test protocol

Influence on vehicle design

• Harmonize severity for all mass range
• improve self protection of light cars
• limit increasing stiffness of heavy cars
• improve partner protection of heavy cars

PDB Barrier is closer to new safety requirements and car design.
Crash Test Programme

PDB and R.94 Barrier, Force-Deflection & Energy Absorption Capability

![Graph showing force-deflection and energy absorption comparison between current barrier and PDB barrier.](image-url)
## Crash Test Programme

### Crash Test Programme Phase 1 and 2

<table>
<thead>
<tr>
<th>PDB Tests</th>
<th>FWDB Tests</th>
<th>Car to Car Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volvo XC90</td>
<td>Volvo XC90</td>
<td>Focus vs Focus</td>
</tr>
<tr>
<td>Honda CRV</td>
<td>Honda CRV</td>
<td>Focus vs Astra</td>
</tr>
<tr>
<td>Mercedes E-Class</td>
<td>Mercedes E-Class</td>
<td></td>
</tr>
<tr>
<td>MMC Smart</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Ford Focus (raised LCW)</td>
<td></td>
</tr>
<tr>
<td>Golf V</td>
<td>Golf V</td>
<td>Golf V vs Golf V (60mm ride height diff.)</td>
</tr>
<tr>
<td>Astra MY 04</td>
<td>Astra MY 04</td>
<td>Astra vs Astra (60 mm ride height diff.)</td>
</tr>
<tr>
<td>Focus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Crash Test Programme Phase 3 and 4

### Decision Point 1 (16 crash test units remaining)

<table>
<thead>
<tr>
<th>Car 1</th>
<th>Car 2 / Barrier</th>
<th>Comment</th>
<th>Purpose</th>
<th>Test Lab</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panda</td>
<td>Astra '04MY</td>
<td>Closing Speed 112 km/h</td>
<td>To investigate if performance of small car is improved against car with two load path levels (Panda 850 / A 1240(1.46) G 1200 (1.41))</td>
<td>BASSt</td>
</tr>
<tr>
<td>Panda</td>
<td>Golf MkV</td>
<td>Closing Speed 112 km/h</td>
<td>Demonstrate improved structural interaction of Golf due to Astra subframe load path. (Golf cf lowered Golf)</td>
<td>TRL</td>
</tr>
<tr>
<td></td>
<td>PDB</td>
<td>Test speed 60 km/h</td>
<td></td>
<td>UTAC</td>
</tr>
<tr>
<td>VW Touareg</td>
<td>Golf St</td>
<td>Closing Speed 112 km/h</td>
<td></td>
<td>BASSt</td>
</tr>
<tr>
<td>VW Touareg</td>
<td>Astra</td>
<td>Closing Speed 112 km/h</td>
<td></td>
<td>TRL</td>
</tr>
</tbody>
</table>

### Crash Test Programme

- **Crash Test Programme Phase 3 and 4**
- **Decision Point 1 (16 crash test units remaining)**
- **To date: 6 PDB, 7 FWDB, 4 CtC (21 of 43 units)**
- **Fiat**

### Investigate impacts with mass ratio difference (less than 2.0)

<table>
<thead>
<tr>
<th>Car 1</th>
<th>Car 2 / Barrier</th>
<th>Comment</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panda</td>
<td>Panda</td>
<td>Raised / lowered to give 60 mm ride height difference</td>
<td>To establish structural interaction performance of Panda and compartment strength</td>
</tr>
<tr>
<td></td>
<td>TRL</td>
<td>Test speed 56 km/h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>FWDB</td>
<td>Test speed 56 km/h</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PDB</td>
<td>Test speed 60 km/h</td>
<td></td>
</tr>
</tbody>
</table>

- **Frontal force level measurement, compartment intrusion measurements**
- **Demonstrate improved structural interaction of Golf due to Astra subframe load path. (Golf cf lowered Golf)**
- **Investigate if performance of small car is improved against car with two load path levels (Panda 850 / A 1240(1.46) G 1200 (1.41))**
Further Progress:

Both favourite test Procedures are under critical consideration and further development:

- **November 2005**:  
  - Collating crash test data  
  - Summary of crash test results

- **January 2006**:  
  - Finalising summary of crash test results  
  - EEVC WG 15 establish conclusions  
  - Commence of drafting the test procedure/set of test procedures.
**Conclusions:**

Both favourite test Procedures are under critical consideration and further development:

- **PDB:**
  - deformation assessment
  - assessment criteria

- **Full Width:**
  - deformable element stiffness
  - homogeneity criteria
  - definition of area to be assessed
Possible Sets of Legal Frontal Impact tests to Assess Compatibility

Set 1:
• PDB Test Procedure replacing ECE R.94 (structure test) with barrier deformation analysis
• Maintain or/and improve restraint system tests

Set 2:
• Maintain ECE R. 94 (structure test)
• Full Width Barrier Test With Deformable Front Face (restraint test, additional airbag sensing).

Set 3:
• PDB Test Procedure replacing ECE R.94 (structure test)
• Full Width Barrier Test with or without Deformable Front Face
Illustration of Compatibility Problem

Horizontal Geometrics

Note: to be completed

Top View

Tonareg (width 1928mm)

Astra (width 1753mm)

EEVC WG 15, Compatibility Between Cars

38th GRSP, Dec. 06 - 09, 2005
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Vertical Alignment

Illustration of Compatibility Problem
Illustration of Compatibility Problem

Photo Astra
Illustration of Compatibility Problem

Photo Touareg