Considerations for A Side Impact Test Procedure for approving CRS in EU

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7th GRSP Informal Group on CRS – BAST, Cologne 21 January 2009
Informal Group Objectives - Reminder

Develop definitions, performance criteria and test methods for an ISOFIX Integral “Universal” CRS

- Test bench
- Classification
- Dummies
- Dynamic tests [Including Side Impact]
- Interoperability with vehicle
Side Impact - Objectives

- Informal Group to review all existing methods to determine the one to be retained
- Informal Group to consider first methods delivering required energy level and:
  - Promoting energy absorption in the seat
  - Including measurable performance criteria
- Supported by ISO/TC22/SC12 (Alternative1)
  - To provide essential input parameters only for a CRS side impact test method.
  - Delivery date from ISO: June 2009
Field Studies & Key Findings
Analysis of CHILD Data Related to Side Impacts*

Injury Severity Struck Side & Non Struck Side
284 Restrained Children

Injury Severity Struck Side
157 Restrained children

Higher risk on struck side!

* Analysis of CHILD Data Related to Side Impacts : Philippe Lesire - Protection of Children in Cars – 7/8 December 2006 - Munich
• ¾ of injuries to the head and face (seat group 0 to 1)
• Neck in 2nd position
• Abdomen & lower limbs in 3rd position
Struck Side (Ranking)
- Head (impact on rigid part of the vehicle)
- Neck (often with brain injury)
- Chest (shell, boosters, Seat Belt)

Non Struck Side
- Head - impact on rigid part of the car
- Chest

Intrusion >300 mm
- 50% of children MAIS4+

* Analysis of CHILD Data Related to Side Impact (Philippe Lesire) - Protection of Children in Cars – 7/8 December 2006 - Munich
62 crashes investigated – Nearside, Center & Farside*

Body Regions of Injury (AIS2+, n=170)

- 70% of injuries to head and face (118/170)
- Thorax in 2\textsuperscript{nd} position (13/170)
- lower limbs & Abdomen in 3rd & 4th position (13/170; 10/170)

In Depth analysis of 21 nearside cases

Involved Physical Components – Head and Face (n=34 injuries)

Key Message
- Vehicle Components 61%
- CRS Components 24%
- External Intruding Objects 9%
- Other Occupants 6%

In Depth analysis of 21 nearside cases

Involved Physical Components – Other Body Regions
- Thorax
- Abdomen & Lower Extremity (n=15 injuries)

Key Message
- CRS Components 46%
- Vehicle Components 41%
- Other Occupants 13%

**In Depth Study of 8 side Impact crashes**

- **Most frequently injured body areas**
  - Head, Face, Lower Extremity
  - Need for a biofidelic dummy
- **Side crashes, in addition to lateral component**
  - Include a forward component
- **Intrusion can be direct or indirect**
  - Direct: Car structure contacting the occupant (direct)
  - Indirect: Vehicle part such as front seat intruding into occupant space
- **CRS rotates towards the site of impact**

SUZANNE TYLKO, Transport Canada, Ottawa, Ontario, Canada
NICHOLAS TAMBORRA and RICHARD M. MORGAN, FHWA, NHTSA - Traffic Injury Prevention 2005
Summary Field Accident Studies

- Body Areas requiring attention
  - Head & Face
  - Lower extremity

- Test procedure
  - Dynamic (sled test) with assessment of interactions of intruding door
  - With lateral and forward components
  - With lateral rotation of the CRS (armrest contact)

- Dummy
  - With design capability and appropriate injury criteria
The Physics
Barrier to car Side Impact – EuroNCAP 50 km/h - 90° barrier test to vehicle

Y-Velocities m/s

Velocities vs. Time

Bullet Car

Target Car

P3

P1 ½
• Test energy to be based on dummy velocity change 9 to 10 m/s (Reference Iso Boundary Conditions in N818 Doc)
• EuroNCAP Side Impact can be considered as a basis for a energy definition for a test procedure for CRS
Status of existing test methods
## Status of existing test methods

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<th>Country</th>
<th>Australia</th>
<th>USA</th>
<th>ISO</th>
<th>NPACS EU</th>
<th>Stiftung Warentest ADAC EU</th>
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<td>Q3S + New Neck</td>
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<td>Q Dummies &amp; P10</td>
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<td>Status</td>
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<td>Research Stage</td>
<td>Disapproved</td>
<td>in use in UK 2007</td>
<td>in use since 2002</td>
<td>EU since 1997**</td>
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* Body in white and deceleration pulse modified from Golf 4 to Astra  
** Child assessment protection protocol introduced in 2003

- **Fixed Door approach: SV ADAC (long experience) & Australia**
- **Dynamic Intrusion approach: 3 methods**
  - 1 in use in 1 country NPACS
  - 1 in development USA, CAN
  - 1 ISO dissaproved
Side Impact Test Procedure – Timeline Constraints

**Keys**
- Draft to GRSP must be circulated and discussed prior sending to GRSP
- Draft Ready by September to be considered as formal document
- Allows July & August for discussion of the draft
- Text ready by June 09
Need for a pragmatic approach to deal with side impact test procedure

- 1. Real world data point at a dynamic sled test with intrusion simulation, including biofidelic dummy and appropriate injury criteria.

- 2. Real world data also point at the need to reduce vehicle intrusion and improve vehicle interior energy absorption

- 3. Today such a test method for CRS as in 1 is not available and for vehicles, test method to control direct intrusion exist worldwide (ECE95, FMVSS 214 etc...), but no provision exist for instance for door energy absorption

- 4. Let us aim at a simple, feasible and comprehensive approach involving improvements both CRS and vehicle

- 5. Let us consider head protection as a key fundamental objective to achieve

Approach proposed:
- 2 step approach to deal with the issue
A Step by step approach Proposed To the Informal Group: Phase 1 – Option

Phase 1 : Head Containment & Energy Absorption for the CRS & Vehicle interior Energy Absorption

**CRS**

Head Containment & Energy Absorption – Pendulum Test – Impact energy TBD from EuroNCAP Side Impact

Performance Criteria
Using Q Dummy with acceptable Head Neck Kinematics
Head Containment Y/N from video analysis (NPACS or Stiftung Warentest)
For energy absorption, Head Acceleration based criterion

**Vehicle**

Energy Absorption of vehicle parts using ECE21 principle on door interior and rear of the front seat

Performance Criterion
Pendulum 3ms Acceleration < XX G’s
Analogy with ECE 21 energy dissipation of vehicle interior
A Step by step approach Proposed To the Informal Group: Phase 1

**Phase 1 : Head Containment & Energy Absorption for the CRS & Vehicle interior Energy Absorption**

**CRS**

- Head Containment & Energy absorption - Sled Test – Fixed door – ADAC Generic Pulse $\Delta V$ 28 km/h, 80°

**Vehicle**

- Energy Absorption of vehicle parts using ECE 21 principle on door interior and rear of the front seat

**Performance Criteria**

- Using Q Dummy with acceptable Head Neck Kinematics
- Head Containment Y/N from video analysis (NPACS or Stiftung Warentest)
- For energy absorption, Head Acceleration based criterion

- Performance Criterion
  - Pendulum 3ms Acceleration < XX G’s
  - Analogy with ECE 21 energy dissipation of vehicle interior
Step by step approach Proposed To the Informal Group: Phase 2

Phase 2: Intrusion based sled test & Vehicle Energy Absorption & Vehicle Control of indirect intrusion

**CRS**
- Intruding Door Test TDB (example below only)
- Slide seat mass: 100kg
- Contact surface: 400mm x 150mm
- Impactor
- 100mm
- 300mm
- 250mm
- Aluminum honeycomb

**Vehicle**
- Energy Absorption of vehicle parts using ECE21 principle on door interior and rear of the front seat
- Performance Criterion
  - Pendulum 3ms Acceleration < XX G’s
  - Analogy with ECE 21 energy dissipation of vehicle interior
- Vehicle Control of indirect intrusion*
- Objective: limit the intrusion into the rear occupant space of front seat back (situation seen in side impact accidents with frontal component)
- Test Method to be defined

* Based on M. Maltese Stapp 07 Paper
Informal group to consider for discussion proposed steps for both CRS and Vehicles

Must find a compromise in terms of

» Timeline: Draft to be circulated, approved and circulated to GRSP by 2nd week of Sept
» Feasability of the procedure given available data and tools (dummies)
» Capacity of the both CRS and test procedures to address the key body injury area: Head & Face!