

GRSP Informal Working Group  
Frontal Impact  
Review of Open Questions

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- » Sweden identified 7 questions relevant to the group
- » Following slides represents the status of the group's progress for these questions as interpreted by VTI

- » **Is an accident analysis needed to update information on changing vehicle fleet?**
- » *Background: R94 is based on a reference crash of 50 km/h car-car crash 50% overlap. Does this reference need to be updated to reflect other frontal crash conditions? For example, how relevant are crashes between passenger cars and heavy goods vehicles, roadside obstacles etc.*

- » Different accident analyses have been presented by France, Sweden, VDA
  - » French and German data show an increased risk for small vehicles in car-car accidents
  - » VDA (German Industry) does not see any issues in current accident data that PDB will improve
  - » TRL reported in its report to the EC that small cars are risk with mass ratios up to 1:1.6

- » Safety has improved but there is a clear indication that modern vehicles under 1500 kg have a higher accident risk than heavier vehicles
- » Small car safety must be enhanced particularly with the pressures to downsize vehicle mass

- » **Identify critical injury mechanisms (in particular relevance of thorax injuries in high deceleration pulse type accidents)**
- » *Background: Information presented was presented from the UK to EEVC WG15 in 2006. The information showed an increase in chest injuries for newer vehicle models. Does this information suggest specific restraint system tests are necessary (for example a high pulse test)?*

- » Swedish data was not able to identify any new injury issues
- » Conflicting data has been presented to the group
  - » French Data (FI-03-06e) indicates improved chest protection
  - » UK and GIDAS Data indicates that chest injuries are a sensitive body region for fatal injuries
  - » Swedish data does not show a dramatic change in the relative number of thorax injuries in the total number injuries reported

- » No clear evidence that Thorax injuries are dramatically increasing
- » Improvements in total safety can be achieved with continued focus on head and chest injuries

- » **Assess potential for harmonisation for frontal impact procedures.**
- » *Background: The USA and Japan both require a full frontal impact test procedure and Japan also requires an offset test procedure (R94). Changes to R94 that can be incorporated into a global frontal impact standard would be beneficial for European industry and would allow for better frontal impact protection.*

# Question 3

» VDA presented the following figure. Europe is the only significant auto producing area without a full width test

	Regulation			Consumer Testing		
Europe						
USA						
Japan						
Australia						
China						
Taiwan						
India						
Gulf States						

- » A combination of offset and full width tests is important to avoid sub-optimisation of vehicle safety
- » The addition of a full width test in Europe can address the casualty rate attributed to accidents with distributed frontal contacts (over 50%)
  - » The highest risk group identified in TRL report to the Commission
- » The introduction of a PDB barrier in Europe must be made in conjunction with a larger global strategy for offset barrier testing

## Question 4



- » **Finalise the test severity for regulation test – determine acceptable minimum values for vehicles.**
- » *Background: The reference car-car test in R94 assumes a collision partner identical to the test vehicle. Compatibility research shows that the energy absorption demands for small cars and large cars are different in a fixed barrier test procedure. A test severity metric (such as Equivalent Energy Speed –EES) should be determined for the test vehicle based on the vehicles mass. One example is to use a reference collision partner of a set mass so that small cars have higher EES speeds than heavy vehicles. Accident analysis and collision probability models could define a minimum required EES for all vehicles in the test category. As example, a median vehicle mass for the European fleet (approx 1500 kg) could be used*

- » There has been no comments on the minimum EES to be ensured by regulation.
- » Accident data and accident risk data suggest that a car-car reference can be identified for 100-112 km/h with a 1400-1600kg impact partner
- » Single vehicle accident data has not been presented that can define a reference collision (up to the 6th meeting)

- » Self protection should be identified by a minimum crash condition (preferably pre-crash energy) for all cars, regardless of mass that addresses
  - » Car-car Collisions (issue for small cars)
  - » Single vehicle collisions (issue for heavy cars)
- » It is important to identify the crash configuration for single vehicle crashes to ensure the proper test conditions are selected
  - » Are distributed damage or localised (pole) impacts relevant for large vehicles?

- » **Validate the PDB EES calculation method**
- » *Background: PDB test results to date are reported with the EES experienced by the test vehicle. The data is based on a calculation of the energy absorbed by the PDB. This calculation cannot be directly verified. Thus the EES value determined in **Question 4** cannot be positively confirmed for the PDB.*

- » France has presented data and has updated software (<http://www.pdb-barrier.com/>) to calculate EES
- » No other independent data to validate energy absorbed in barrier has been presented

- » **Validate that the PDB test guarantees a minimum EES test severity for all vehicles.**
- » *Background: The test severity defined under Question 4 must be ensured to be enforced with the PDB. Sufficient test and simulation data does not exist to confirm the PDB can achieve this. The PDB energy absorbing capacity will allow a completely rigid vehicle (a steel block) to have acceptable test results for occupant protection. Although these vehicles are unlikely to be designed, there is the theoretical potential for an acceptable test result with an unacceptable vehicle.*

- » Test data from NHTSA with vehicles tested to both current R94 and PDB protocols show that the PDB pulse is more severe – higher average pulse.
  - » Confirms French data
- » Japan has conducted tests with a minicar where the EES was lower than the R94 test
  - » Intrusion greater in PDB test compared to R94 but less deformation of lower longitudinal
    - » Vehicle ruptured PDB cladding
  - » NHTSA test with Chevrolet Aveo produced greater vehicle damage (intrusion and frontal structure)
    - » No PDB cladding rupture

- » Vehicles producing PDB cladding ruptures tend to have lower EES values than similar vehicles that do not rupture the PDB

- » **Validate that PDB provides the required test requirements for interior restraints**
- » *Background: In connection to **Point 2** and **Point 4** the PDB may produce a test that does not sufficiently test the restraint system to address certain injuries.*

- » Japanese tests were presented to compare R94 and PDB tests
  - » PDB produced slightly higher dummy values but almost all test results (PDB or R94) were far below threshold values
- » NHTSA test results do not show significant changes in the dummy values for their PDB and R94 tests
- » Complementing the PDB with a full width test can provide a better test of restraint systems over current R94

- » Accident analysis indicate that small vehicles have higher injury risks
- » A new reference crash for frontal collisions is needed to identify future R94 requirements
- » A threshold value for EES (or similar concept) is needed for the group to progress

- » Although the French Data shows the PDB increases the test severity for small cars, the Japanese contribution to the working group does not support this result.
- » The PDB was designed to promote compatibility by measuring how a vehicle deforms the barrier
  - » The PDB provides higher accelerations for cars reviewed but this may not always be seen in dummy readings. Vehicles puncturing the barrier do not exhibit higher compartment intrusion than R94.
- » For the information presented to the group, the current PDB proposal requires additional test requirements if it will perform as desired for regulation
  - » Addition of full width test
  - » Requirements of barrier deformation (e.g. no penetration of cladding)

- » Sweden appreciates the French initiative and GRSP has benefited from the information brought to the informal group
- » Sweden supports improvements to R94 especially if they address small car safety.