Compatibility Assessment: can the current ADAC MPDB test properly assess compatibility?

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I. INTRODUCTION

Car-to-car compatibility has been an international concern for decades. In Europe a sequence of three large EU-funded projects (EUCAR COMPATIBILITY, VC-COMPAT and FIMCAR) and the European Electric Vehicle Congress (EEVC) [1-4] have addressed this issue. While no consensus was achieved in any of these projects, the FIMCAR project developed an agreed definition for compatibility and proposed a future frontal impact assessment approach. The FIMCAR proposal was presented, but it was not approved by Global Road Safety Project (GRSP) or Euro NCAP. The items addressing partner protection were considered to make homologation, or the consumer information testing, too complicated.

Euro NCAP has recognised the lack of partner protection (structural engagement) in the European frontal impact assessment and subsequently updated the roadmap for 2020 with the definition of a mobile barrier for offset frontal impact protection, which is planned to be adopted in 2020. A Euro NCAP Working Group, which is led by ADAC (Allgemeiner Deutscher Automobil-Club), is in place in order to develop the new protocol. Following ADAC announcements [5], it is expected that the Euro NCAP frontal impact mobile deformable barrier (MDB) test procedure will be based on the ADAC mobile progressive deformable barrier (MPDB) protocol. Recent publications of ADAC MPDB test results [5] indicate that basic agreements of the FIMCAR project w.r.t. compatibility requirements are not considered in detail. The objective of this paper is to compare the main findings of FIMCAR with the current developments.

II. METHODS

FIMCAR results in brief

According to the FIMCAR definition, compatibility consists of self and partner protection. Improved compatibility will decrease the injury risks for occupants in single and multiple vehicle accidents. Compatible vehicles will deform in a stable manner, allowing the deformation zones to be exploited even when different vehicle sizes and masses are involved. According to the FIMCAR accident analysis involving post-ECE R94/Euro NCAP developed passenger cars, there is a considerably high risk for severe and fatal injuries in frontal impact accidents against heavy vehicles (such as buses, Heavy Goods Vehicles, etc.) and objects, although these accidents occur less often than car-to-car accidents. The highest priority compatibility topics to be solved are alignment of load paths, load spreading (including multiple load paths and connection of load paths), energy absorption management, sufficient compartment strength for single vehicle accidents, and the improvement of the restraint system capacity addressing a range of pulses [4].

Taking into account the compatibility definition and the priorities, FIMCAR proposed to maintain the current off-set procedure, complementing it with a full-width test against a deformable barrier face, including the assessment of load path alignment using barrier-mounted load cells [4].

ADAC compatibility assessment in brief

A. Assessment Procedure

The ADAC Compatibility Assessment Procedure is based on a MDB 50% off-set test with a closing speed of 100 km/h (test car and MDB are each moving at 50 km/h). The barrier face is a Progressive Deformable Barrier (PDB), which is considerably stiffer and more stable compared to the ECE R94 barrier face. The compatibility assessment is visualised based on the local PDB deformation depths. In addition, the standard deviation of the PDB deformation depths in the assessment area and the energy input into the barrier are assessed [5-7].

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B. First Publication of Test Results

In February 2016 ADAC published the first test results according to the Compatibility Test using three mid-size cars (Honda Civic, Renault Mégane and VW Golf). The vehicles were rated good (Honda), sufficient (Renault) and marginal (VW) [5].

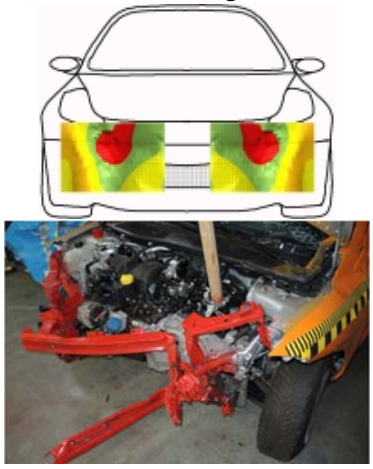
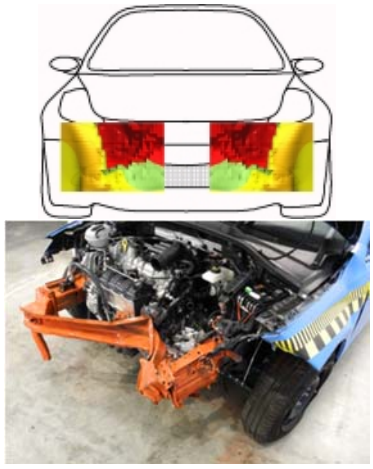
Honda Civic	Renault Mégane	VW Golf
		
Firewall intrusion resulting in high leg readings.	Driver airbag bottomed out, resulting in high chest readings.	Low dummy readings across all body regions.

Table 1: Results of first published ADAC Compatibility Test [5]

III. INITIAL FINDINGS

From the published data it appears that the front structure of the Honda is relatively weak, resulting in a load path formed by the engine and the firewall, on the one hand, and by the front wheel and the sill, on the other hand. By using the engine and the front wheel as load paths, the good homogeneity of the barrier deformation can be explained. In addition, the self-protection seems to be at low level, as shown by the cabin intrusion. For Renault and VW it appears that the cross beams are relatively weak compared to the longitudinal. It appears that the load spreading in the VW is slightly better than in the Renault, resulting in larger areas of red barrier deformation in vertical and horizontal direction. The VW has more localised stiffness than the Renault, as seen in the more abrupt change of deformation contours from yellow (low) to red (very stiff).

IV. DISCUSSION

It appears that the ADAC Compatibility Test may sacrifice self-protection for partner protection, which limits its application in Euro NCAP. The current ADAC assessment procedure does not clearly promote structural alignment given the large vertical and unrestricted horizontal assessment area. Further motivation of the compatibility metric based on deformation depth, independent of a well-defined horizontal and vertical assessment area, is needed to confirm that self-protection is not compromised, particularly for heavier vehicles.

V. REFERENCES

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