

Prof. Dr. -Ing. Hermann Appel

Discussion of the Paper:

## **Car Safety and Ratings: Comparative Study of Facts and Practices - Proposals**

*C. Tarrière, C. Thomas and J.Y.Foret Bruno*

*Automobile Biomedical Department*

*Research Department of RENAULT*

*Laboratory of Accidentology and Biomechanics*

*PSA Peugeot-Citroën / RENAULT*

### **Object of the Investigations, Questions Discussed**

In recent times, various methods of assessing the crashworthiness of passenger cars on an experimental basis have been published, the aim being to achieve results as near to the real occurrence as possible. These experimental methods are discussed here from the following three aspects:

- are acceleration values the relevant causes of injury?
- are intrusion values the relevant causes of injury?
- which protection criteria are to be specified in each of the above cases?

Corresponding to these questions, the study distinguishes between collisions with high passenger compartment acceleration levels and collisions with low acceleration levels, but with local intrusions.

### **Analysis of Real-World Accidents**

First of all, the results of the researcher's own accident investigations are reported in relation to the three questions. On the basis of three selected examples with

- high intrusion and low injury severity, and
- low intrusion and high injury severity,

the authors propose the hypothesis that, in cases of frontal impact, intrusions are less responsible for the severe injuries of MAIS 3+ than the acceleration levels of the passenger compartment.

Furthermore, from the evaluation of several thousand accidents, it was concluded that the overlap in the studied head-on collisions causing severe injuries with MAIS 3+ was relatively high, i.e. approximately 70%.

This is in agreement with the results obtained by Loughborough University, but not with those of the Mercedes-Benz company.

The theory that deceleration levels are the main cause of injuries is further supported by the fact that higher driver fatality rates only occur with extreme large intrusions on the driver's side.

### **Present-day Crashworthiness Assessment Procedures**

The most important currently-used rating procedures for frontal impacts differ with respect to the evaluation of impact velocity, overlap and protection criteria:

- The ADAC (German automobile association) test procedure emphasises the intrusions for an overlap of 40% and utilises proprietary subjective protection criteria.
- The AMS test procedure is stricter - with 50% overlap, it places great emphasis on intrusions and gives less attention to deceleration levels. It also utilises subjective protection criteria as well as the protection criteria which are generally accepted nowadays.
- The NCAP test procedure places very little emphasis on intrusions, but stresses the deceleration for collisions with 100% overlap.

The authors do not believe that the ADAC test provides sufficiently significant results, whereas the other two tests both cover more realistically the extreme types of collision.

### **Conclusions, Proposals**

A test with an overlap of approximately 60% to 70% is proposed in order to find the correct mix of deceleration and intrusion evaluation for a single test.

The protection criteria should be extended to include measurement of the thorax deflection, cervical spine risk and submarining, the HIC value should be raised to 2500 and an anti-aggressiveness criterion should be introduced.

### **Discussion**

A positive aspect of the paper is that it is based on a clearly-defined hypothesis and that a clear proposal has been made for the tests with respect to the 60% overlap.

It must be criticized, however, that specific cases have been selected for accident analysis and that the hypothesis that acceleration is the main cause of injuries has not been checked more thoroughly. The role of the airbag, which is widely discussed, is not outlined clearly in the initial hypothesis. Will the introduction of airbags lead to an increased significance of acceleration as opposed to intrusion as evaluation criteria?

Finally, the proposals for extended protection criteria and an aggressiveness criterion are not directly related to the hypothesis formulated in the paper. These proposals give the impression that they have just been added as an afterthought.