Status Report and Future Development of the Euro NCAP Programme

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ABSTRACT

Euro NCAP has prevailed as the uniform consumer protection crash test programme throughout Europe. It delivers information about occupant protection during frontal and side impact collision and about pedestrian protection. Since the start of the programme in 1996 nine test series have been conducted so far and a total of about 100 vehicle models have been analysed.

The test procedures are founded on real life accident studies and have been developed on the basis of current standards or drafts. However impact speeds and vehicle occupancy in some cases exceed the defined values. The rating system uses dummy loading as well as dummy and vehicle related modifiers. Both test and rating procedures continuously are tuned and developed further in close co-ordination with research and industry. For this Euro NCAP has established a route map for the next 10 years.

During the ongoing short time phase existing modifiers are objetivized and additional modifiers are introduced. Additionally integration of child restraint performance in overall rating are under discussion. For the second medium time phase new procedures such as rear impact / whiplash protection tests are planned.

INTRODUCTION

The initial idea to conduct consumer protection crash testing comes from the USA where since the beginning of the 80s frontal impact testing of the most important new vehicle models launched on the market has been performed under the US NCAP (New Car Assessment Programme). The aim was to provide consumers with information on occupant safety and to put pressure on manufacturers to permanently improve the safety performance of their products.

In 1987 consumer protection crash testing was introduced in Europe on the initiative of the automobile clubs under the leadership of ADAC. Some years later the magazines Auto, Motor und Sport, AutoBild and in 1996 a British consortium lead by the TRL (Transport Research Laboratory) followed.

There were no standard testing procedures. ADAC and TRL at a very early stage used the deformable barrier but impact speed and barrier were not identical. Auto, Motor and Sport crashed the cars against the rigid wall. For car manufacturers it was often very difficult to meet the requirements, resulting from this diversity, in production. And the various discrepancies of results led to ambiguities in consumer information.

With the support of the European Commission and the FIA, standard testing and rating procedures have prevailed in Europe under the name of Euro NCAP. They provide information on occupant protection and pedestrian friendly design. The Euro NCAP test procedures are developed out of real life accident statistics and continuously are adapted according to the latest findings.

EUROPEAN ACCIDENT STATISTICS

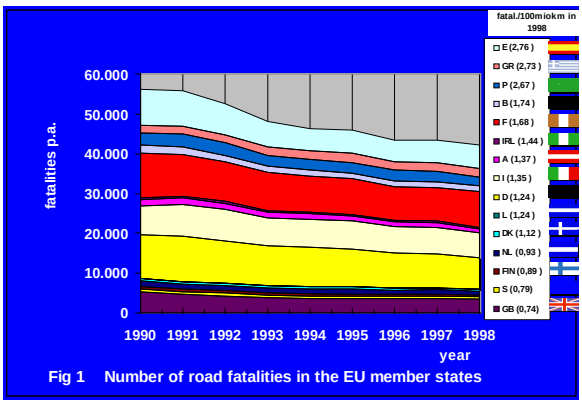

Figure 1. Number of road accident fatalities in the EU member states

Figure 1 shows the annual number of road fatalities in the EU member states. Since 1990 the overall numbers reduced from 56,000 to 43,000 in 1998. Due to increasing mileage the decrease is slowing down. To get further absolute reduction car safety continuously must be improved.

The right column in Figure 1 indicates the 1998 fatality rates for the individual countries, in terms of fatalities per 100 million km. With a figure of about 0.7 Great Britain and Sweden turn out to have the lowest rates. However Greece and Spain being at the other end of the scale demonstrate with 2.7 nearly four times higher rates. One reason of high rates undoubtedly is the low safety belt using rate. Safety belt reminders in all car models would be an adequate measure to increase safety belt usage.

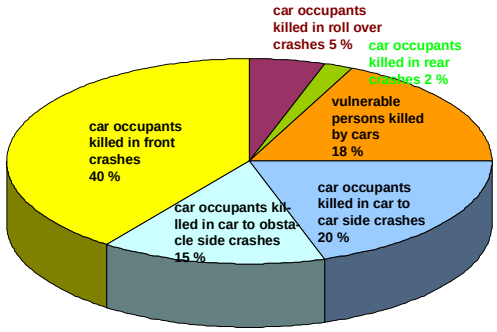

Figure 2. Fatality rates for the individual collision categories

EU wide there occur 35,000 fatalities p.a. with car involvement. As indicated in figure 2 40% are car occupants killed in front crashes, 20% in car to car and 15% in car to obstacle side crashes. 18% are vulnerable persons, predominantly pedestrians, killed by cars.

Although, rear impacts only show a 2% share on all fatalities, improvement of rear impact performance is a great issue in respect to whiplash injuries. These injuries are not life threatening but injured people could suffer strongly and these injuries annually create some 10 billion Euro of costs throughout Europe.

NCAP TEST PROCEDURES WORLD WIDE

Consumer crash test programmes are running in Europe, US, Australia and Japan. The individual test procedures are listed in figure 3.

	Euro NCAP	US NCAP	IIHS	A NCAP	J NCAP
rigid wall full frontal impact		56 km/h H III H III		56 km/h H III H III	55 km/h H III H III
offset deformable barrier (EEVC) frontal impact	64 km/h H III H III P3 P 1 1/2		64 km/h H III	64 km/h H III H III P3 P 1 1/2	64 km/h H III H III
mobile barrier side impact	50 km/h EEVC barrier EuroSID I P11/2 P3	62 km/h crab barrier SID SID		50 km/h EEVC barrier EuroSID I P11/2 P3	55 km/h EEVC barrier EuroSID I
side pole impact	29 km/h flying floor EuroSID I				
pedestrian bodyform impacts	40 km/h adult head child head upper leg lower leg				

Figure 3. NCAP test procedures world wide

With the view to cover most of the real life accidents with severe injuries the car models in Euro NCAP originally are tested in the following configurations:

- A frontal 64 km/h impact of the test vehicle against the fixed deformable barrier with a 40% overlap, simulation a car to car front crash.
- A 50 km/h impact of a movable barrier against the driver side of the test vehicle, simulating a car to car side crash.
- 18 body form impacts with 40 km/h against dedicated points on front bumper and bonnet, simulating child and adult pedestrian impacts.

By carrying out front, side and pedestrian impact tests Euro NCAP is believed to cover 78 % of the main collision types with high accident severity.

With the help of a 32 point and a 4 star rating system the crashworthiness findings for the individual car models are published in a form which easily can be understood by the consumer [1 and 2].

EURO NCAP POLE TEST

In order to enlarge the coverage of Euro NCAP in 2000 a pole side impact was introduced, simulating a car to obstacle side crash, figure 4. This test is carried out for car models with side head protection systems in the case where the standard side impact test already comes up with maximum point score in head protection. The pass criteria for the pole test are for the dummy to record a HIC of 1000 or less and a peak resultant head acceleration of 80 g or less. By this 2 points are added to the side impact performance of the car model. This additional 2 points open the star range up to 5 stars. However 1 point is to be deducted if there is evidence that the head contacts the pole before the airbag is able to intervene.

Figure 4. Euro NCAP side pole test

EURO NCAP SHORT TIME DEVELOPMENTS

Airbag Bottoming Out – If the head bottoms out a 1 point modifier is applied. For bottoming out detection the resultant head acceleration is used: The acceleration spike associated with the bottoming out take the peak g more than 5 g above the level where the spike starts. The spike will be measured between 2 horizontal lines through the start point and the maximum of the peak, figure 5. The modifier can only be applied either for bottoming out or for head instability.

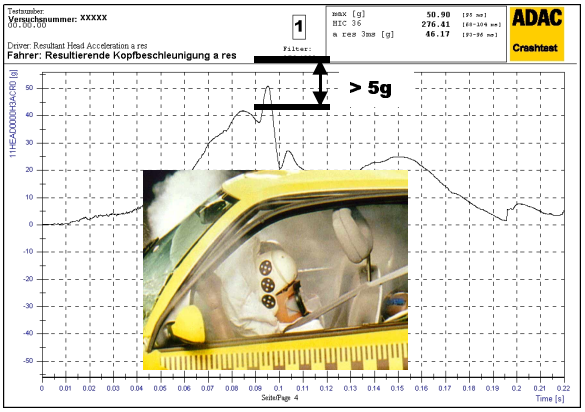

Figure 5. Airbag bottoming out

Pedal Assessment – With the view to take into account the aggressiveness of blocking or broken pedals 2 additional modifiers are under discussion, figure 6. The horizontal intrusion of the most intruding pedal, normally the clutch or the brake pedal, is considered as the primary criteria. Additionally the remaining intrusion after loading the pedal with 200 N is working as a sliding scale modifier. If a pedals breaks sharply an additional 0,5

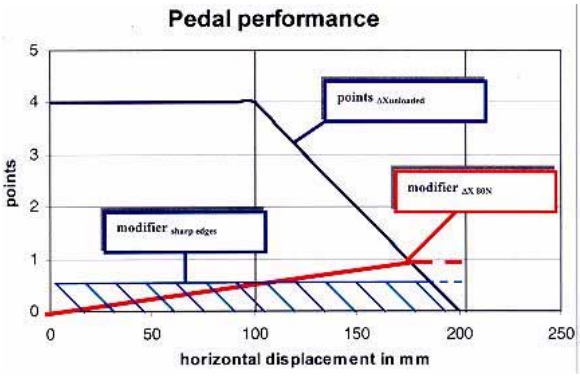

Figure 6. Pedal assessment: horizontal intrusion, blocking (200 N load), sharp edges

modifier is considered. The tests in Euro NCAP phase IX and X should be used for data collection.

Footwell Intrusion – A sliding scale modifier for footwell intrusion is under discussion, figure 7. Here a reference plain for intrusion limit is defined. Unfortunately this idea can come into conflict with efficient damping material in this area to reduce foot injury risk. It is still open if the reduction of the distance between reference plane and footwell safety plane from originally 100 mm to now 50 mm will solve this conflict.

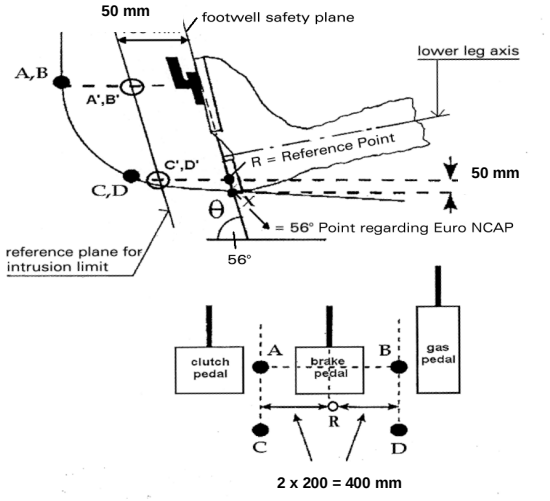

Figure 7. Footwell intrusion

Back Plate Load – The unnatural back plate of the Euro SID I dummy can create load reduction and additionally flat topping on the ribs, figure 8. Both effects reduce rib deflection reading. Comparative tests of the German Bast research institute shows that this problem highly could be solved by using the Euro SID II dummy or at least the Euro SID II back plate for the Euro SID I, figure 9.

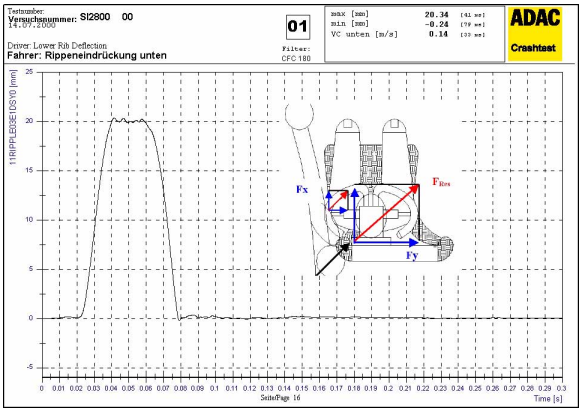

Figure 8. Euro SID I back plate load and flat topping

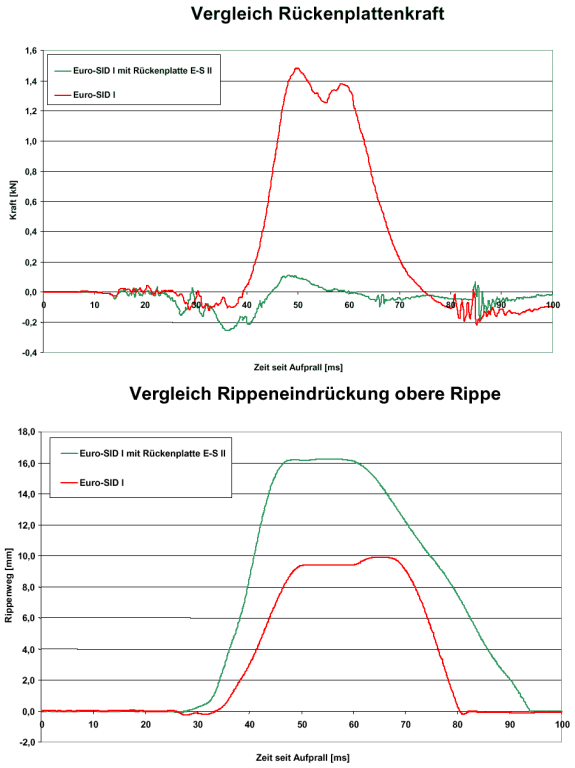

Figure 9. Comparison Euro SID I to Euro SID II back plate: back plate load and upper rib deflection (source: Bast)

The switch to Euro SID II within Euro NCAP also depends on the decision whether this dummy is admitted for type approval. Replacing Euro SID I seems to be the more reliable solution than using a modifier on Euro SID I back plate load.

<u>Child Restraint Rating Methodology</u> –Euro NCAP wants to integrate child restraint performance as soon as possible into over all star rating. For this restraint performance as well as seat and car labelling should be taken into account. For excellent results up to 4 additional points are under consideration. An example for an excellent car airbag warning label is shown in figure 10.

Figure 10. Example of airbag warning labels on sun visor in down and up position meeting both US and Euro NCAP requirements

<u>Knee Mapping</u> – Today's Euro NCAP subjective

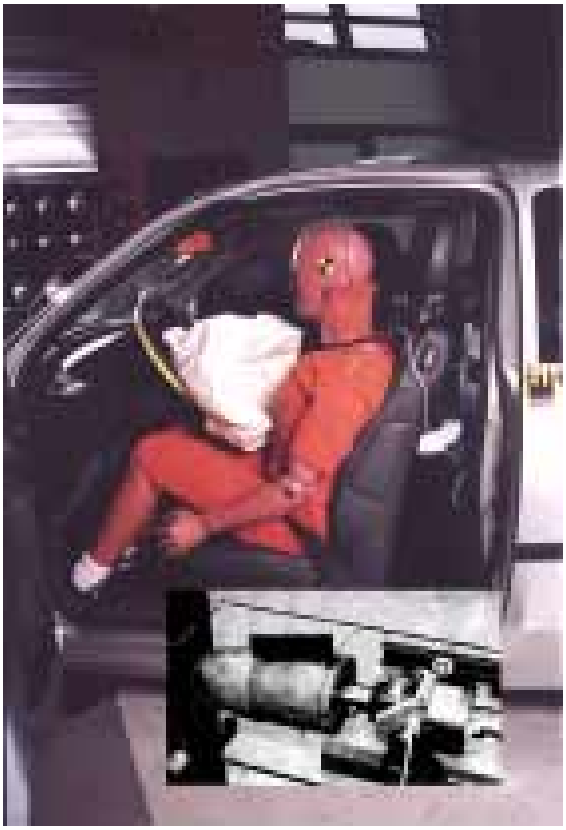

Figure 11. Knee mapping

knee impact assessment should be replaced as soon as possible by an objective component test procedure. The idea is to gain information on knee impact area, knee impact speed and knee impact mass out of present front crash. Zones of the panel which are recognised to be critical by the Euro NCAP inspectors should be impacted by a knee form with the help of a linear accelerator.

Seat Belt Reminders- According to the realization that an increase of the seat belt wearing rate is the simplest way to reduce the fatality rate Euro NCAP has set up a specification for efficient seat belt reminder systems. A system for the driver should result in one additional point, one front seat passenger system one more additional point. A third additional point could be achieved for a reminder or informative system monitoring at least 2 rear seat positions

EURO NCAP MEDIUM TIME DEVELOPMENTS

Rear Impact Whiplash Protection – Real life accident statistics show that rear impact is the most frequent accident and whiplash is the most frequent injury. Therefore the European automobile clubs recently have carried out a comparative test on different car seat models [3]. The outcome was that there are huge differences in injury potential and some models show significant weaknesses. Based on this test a discussion within Euro NCAP has started with the view to introduce a rear impact test procedure.

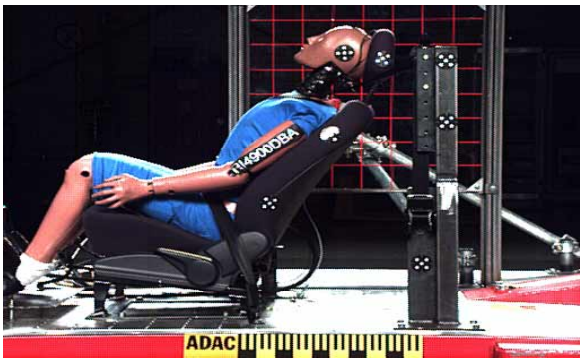

Figure 12. Rear impact whiplash protection test

Figure 12 shows the club's test procedure simulating a 30 km/h car to car rear impact with 6,5 g [4]. Test criteria are the NIC and the Nkm values [5]. A Hybrid III dummy with TRID neck was used. In future the BIORID dummy being more biofidel should be considered. A good whiplash protection is assumed for NIC values lower than 10 and Nkm values lower than 0,25.

With the view to gain information on seat performance in rear impacts with high accident severity a quasistatic stability test should be carried out, figure 13. A good seat stability is assumed for a momentum towards the H point of more than 2400 Nm.

Figure 13. Seat stability test

CONCLUSION

The Euro NCAP activities on car crash worthiness and pedestrian protection have proved an excellent programme for competent consumer information. They have also been highly successful in terms of safety improvement promotion. The continuous adaptation of the testing and assessment procedures in close co-ordination with research and industry to the latest findings guarantees the highest possible quality level for the results.

Within the ongoing short time phase the current modifier system will be completed and objectivized. Additionally child restraint and seat belt reminder performance will be integrated into the over all assessment.

A rear impact test of the European automobile clubs show the feasibility to introduce whiplash protection into the programme.

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