EURO NCAP

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CREATING A MARKET FOR SAFETY

-

10 YEARS OF EURO NCAP

EUROPEAN NEW CAR ASSESSMENT PROGRAMME
2005

THE HISTORY OF EURO NCAP

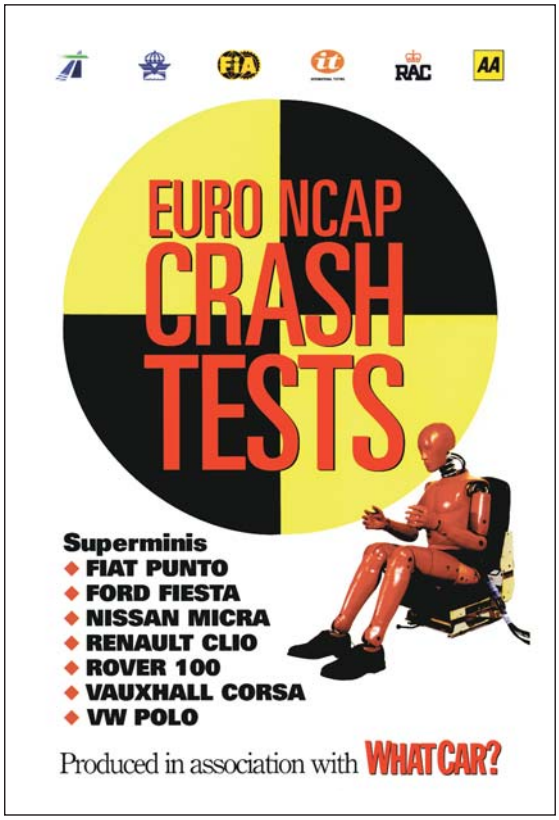
The Background

From the 1970s, a number of European governments had been working, through the European Experimental Vehicles Committee (EEVC), on the development of procedures and equipment for assessing various aspects of car secondary safety. By the early 1990s, this research had resulted in the development of full scale crash test procedures, for protection of car occupants in frontal and side impact, and a component test procedure for assessing the protection of pedestrians, hit by the fronts of cars.

At that time, the only full scale crash test required by European legislation, was a full width rigid block impact. This test was intended to control intrusion of the steering column. No test dummy was present in the car. There were no requirements for either side impact or pedestrian protection.

In the United States and elsewhere, legislation also used a full width block impact test and here test dummies were used to assess protection. In 1979, the National Highway Traffic Safety Administration (NHTSA) started the New Car Assessment Programme (NCAP), where cars were frontal impact tested at the higher impact speed of 35 mph. Much later, an NCAP was started in Australia and one was being developed for Japan.

In Europe, the German motor club, (Allgemeiner Deutscher Automobil-Club) ADAC, and the motoring magazine Auto Motor und Sport, started to commission offset rigid wall frontal crash tests and to publish the results, as consumer information. A single series of frontal tests, using the EEVC offset deformable frontal impact test procedure, was published by European consumer groups. These tests were jointly funded by the UK Department of Transport and International Testing. Despite the lack of modern crash tests requirements, in European legislation, the beneficial effects of consumer information programmes had now become clear.



First Euro NCAP tests published in February 1997

The Initial Proposal

By 1994, proposals for the adoption in European legislation of the EEVC test proposals were being strongly resisted by the car industry. Partly as a consequence, in June 1994, the Transport Research Laboratory (TRL) proposed to the UK Department of Transport that it should consider starting an NCAP in the UK, which could later expand across Europe. This proposal outlined the benefits seen elsewhere from such programmes, proposed that this programme should be more comprehensive and that it should be based on the test procedures developed by the EEVC. The Department of Transport reacted positively to this proposal and initial work was started.

The industry was informed about the work and representatives were invited to discuss the proposal at a meeting the following month. At the meeting, it was explained that the intention was to assess cars using the EEVC Frontal, Side and Pedestrian tests procedures and publish the results as consumer information. The industry's views were sought. At the meeting, the manufacturers' response was very negative with little positive contribution being provided.

In April 1995, the Department of Transport contracted TRL to start development of a new car assessment programme. Immediately, discussions were held with other interested parties, to see how the programme could be expanded across Europe. In July 1995, those interested met at the European Commission to discuss how this might be taken forward. Over the following year, whilst these discussions continued, development of the UK programme continued.

From the beginning, the programme was ambitious. It was more comprehensive than those carried out elsewhere and there was the hope to involve more parties. With the research knowledge available to the programme, there was also a determination to ensure that full advantage was taken to ensure that the testing and assessment was as scientifically based as was possible. In order to benefit from the experience of others, visits were made during November 1995, to those involved in similar programmes elsewhere in the world.

The First Tests

For the first phase of tests, seven supermini sized cars were chosen and the manufacturers were asked to supply information about those cars. For one manufacturer, the existence of the programme had an immediate effect. They asked when the test cars would be purchased, so that they could decide what improvements they could make to their car, before it was purchased. Subsequently, they revealed that they had only had time to increase the steel thickness of some parts of the structure and that the effect was somewhat limited.

By May of 1996, all of the first phase tests had been completed and a presentation was made to the Fifteenth International Technical Conference on the Enhanced Safety of Vehicles (ESV), in Melbourne. In the presentation, the programme was outlined and a report was made on the current state of development. Although, at this stage, all of the tests had been carried out, the assessment, rating and presentation procedures had still to be completed.

Obvious differences in protection could be seen in the first tests

Rover 100 *VW Polo*

For comparative testing, it was clear that the testing had to be carried out to a higher standard than was necessary for legislation, product development or research. In such cases, it is adequate to pass the requirements or interpretation of the results can be supported by engineering judgement. However for comparative testing, the precise, absolute value of the results is important. Because of this, a detailed test protocol was developed and for the test laboratories, it was necessary for some improvements to be made.

For the development of the Assessment Protocol, access to the latest research and personal contacts with most of the World's experts proved invaluable. The European consumer groups, through International Testing, provided support to allow Vehicle Safety Consultants to help with the development of the Assessment Protocol. Their experience in the fields of in-depth accident research and child protection were particularly useful. During this period, further meetings were held with representatives of the car industry regarding the development of the assessment and rating procedures.

A unique feature of the assessment procedure related to the inclusion of information from an expert inspection, carried out on each car. The prime purpose of the inspection is to extend the validity of the assessment to cover a wider range of car occupant sizes, seating positions and impact situations. For the frontal impact, inspection modifiers were incorporated to take account of these factors. Subsequently, modifiers were added for some of the other tests.

The Formation of Euro NCAP

Swedish Transport Minister examines the first 4 star car - Volvo S40 (1997)

In November of 1996, the Swedish National Road Administration (SNRA), the Federation Internationale de l'Automobile (FIA) and International Testing were the first organisations to join in with the programme. This resulted in Euro NCAP being formed. Its inaugural meeting was held in December 1996. Later, in 1998, Euro NCAP achieved legal status when it became an International Association, under Belgian law.

In February 1997, the first results were presented at a press conference and exhibition, at TRL. With the formation of Euro NCAP, the results were presented as Euro NCAP ratings. The release of these first results caused considerable media interest, which was fuelled by the strong negative response of the car manufacturers. On the same day, the car manufacturers held their own press conference, at an exclusive London restaurant, where they heavily criticised Euro NCAP, its tests and its ratings. One of the many claims was that the assessment criteria was so severe that no car could achieve four stars, for occupant protection.

In July 1997, the results from the second phase of tests were published and Euro NCAP was pleased to be able to announce that the Volvo S40 had become the first 4 star car, for occupant protection.

Euro NCAP Grows

From the formation of Euro NCAP, the FIA took the lead in promoting the programme and in discussions with other potential members. As a consequence, more European governments and the ADAC joined. Support for the programme was also provided by the European Commission. Much more recently, Thatcham has joined the programme, on behalf of British Insurers. As Euro NCAP's influence grew, new batches of test results were reported, about twice each year, and car manufacturers started to sponsor the testing of their own cars.

As new car models replaced those already tested, the improvements in their occupant star ratings could be clearly seen. Unfortunately, improvements were far slower to emerge for pedestrian protection.

The first 5 star car – Renault Laguna (2001)

In 1999, operational control of Euro NCAP moved from the UK to a full time Secretariat based in Brussels. This provided greater independence for Euro NCAP, although the experience gained from the early stages was not lost. In that same year, with encouragement from the FIA, Australian NCAP signed a memorandum of understanding with Euro NCAP and aligned its protocols with those of Euro NCAP.

In June 2001, a further milestone was reached when the Renault Laguna became the first car to be awarded 5 stars for occupant protection. Although other cars were awarded 5 stars later, it was suggested that the requirements were too severe for a supermini. This was proved incorrect in November 2004 when the Renault Modus became the first supermini to gain 5 stars. Standards have now risen so much that it is common for cars to achieve this rating and increasingly manufacturers see 5 stars as the goal for all their new models.

A pole test is added to assess side impact head protection (2000)

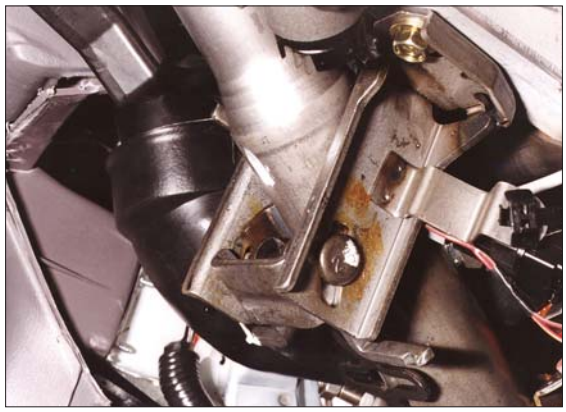
The Pole Test

With the introduction of head protecting airbags for side impact, Euro NCAP considered it necessary to add an optional test, to assess such devices. With no appropriate test being developed in Europe, the US side impact pole test was adapted for use with the European side impact dummy. Using this procedure, the results for the first cars were published in March 2000. It is now becoming the norm for new cars tested by Euro NCAP to be fitted with such airbags.

Knee Protection

One of the most contentious areas of the adult occupant assessment is that related to knee protection. The seating procedure for the adult dummies ensures that the knees always hit the same small areas of the facia, in the frontal impact test. With this knowledge, manufacturers have generally ensured that these areas are relatively free from hazards. However, accident research shows that crash victims can impact their knees on virtually any part of the facia they can reach. Before Euro NCAP, such areas were untested and frequently contained aggressive structures. Such hazards were frequently found in the region of the steering column.

First driver knee airbag - Toyota Avensis (2003)



Inspectors identify potential hazards in the driver's knee impact zone

The Euro NCAP inspectors examine the whole facia area and modifiers are applied to the Euro NCAP score, where hazards are found. Although unpopular with car manufacturers, Euro NCAP's influence in this area has lead to major improvements. Some manufacturers have completely cleared the knee impact zones of potential hazards and in June 2003, the Toyota Avensis was the first car tested by Euro NCAP that was fitted with a knee protecting airbag for the driver. Subsequently, more cars have been tested with knee airbags for the driver and, in some cases, for the front seat passenger.

Pedestrian Protection

Test sites marked out for pedestrian protection assessment

Although improvements in pedestrian protection have been slow to emerge, the Daihatsu Sirion became the first car to be awarded 3 stars for pedestrian protection, in September 2000. Honda showed greater progress with the Civic and other models but too many manufacturers have shown no obvious attempt to address the problem.

Lack of progress was such that, at the beginning of 2002, Euro NCAP revised its pedestrian testing and assessment protocols, in an attempt to encourage manufacturers to make improvements. At the same time, developments reported by the EEVC were also incorporated. Using the revised protocol, the MG TF was awarded 3 stars for pedestrian protection, in January 2003. Subsequently, whereas a few manufacturers have demonstrated significant improvements, other have continued to show an apparent disregard for pedestrian protection.

Encouragingly, in November 2005, the Citroen C6 became the first car to achieve 4 stars for pedestrian protection. This car is equipped with sensor technology to detect an impact with a pedestrian at which stage a "pop-up" bonnet is deployed. Raising the bonnet, in this manner, provides greater clearance over any aggressive structures in the engine compartment. Consequently, when hit by a pedestrian head, the bonnet can deflect to provide increased head protection.

"Pop up" bonnet to improve pedestrian head protection – Citroen C6 (2005)

Child Protection

From the beginning, it was intended that the programme would aim to encourage all car manufacturers to take responsibility for providing protection for children. At that time, some manufacturers expressed the view that protecting children was the responsibility of child restraint manufacturers. Some of them did not even provide child restraints through their dealerships or provide any recommendation to their customers. Euro NCAP's influence soon changed this. There are many aspects of child protection which cannot be influenced by the child restraint manufacturer acting alone and which require action to be taken by the car manufacturer.

Child protection Star rating is introduced (2003)

Initially, the protection afforded to children was simply reported in the text but in 2003 an additional star rating was introduced. In that November, Euro NCAP announced its first child protection star ratings with the Ford Focus C Max being the only car in the first group to be awarded 4 stars. Since then, more cars have achieved this rating and the existence of the star rating has motivated all car manufacturers to aim for good star ratings for child protection.

At the beginning, a single three year old child dummy was positioned, on the rear seat. Later a one and a half year old child dummy was added. In each case, the child dummies are seated in a restraint of the type recommended by the car manufacturer.

First 4 star for child protection - Ford Focus C Max (2003)

Intelligent Seat Belt Reminders

Although Euro NCAP's influence was seen to be improving adult occupant protection, there was concern that this improved protection relied on the proper use of seat belts. As protection for belt wearers improved, accident data increasingly showed that a higher proportion of seriously and fatally injured casualties were not wearing their seat belts. To improve this situation, Euro NCAP developed a protocol to encourage the fitment of Intelligent Seat Belt Reminders. Again, advantage was taken of EEVC research, in the formulation of this protocol.

First car with Intelligent Seat Belt Reminder for all seats – Volvo S40 (2004)

Research had shown that most non-wearers could be persuaded to use their seat belt, if they were given a suitable reminder. Although simple systems have been available for many years, intelligent ones could be almost un-noticed by normal belt wearers but become increasingly aggressive for those who do not "buckle up." However, Euro NCAP was anxious to avoid certain risks that had been identified. For the small proportion of persistent non-wearers, it is important that such systems should not be so annoying that the owner is tempted to tamper with the vehicle wiring. Such action might result in a malfunction of some part of the car's restraint system.

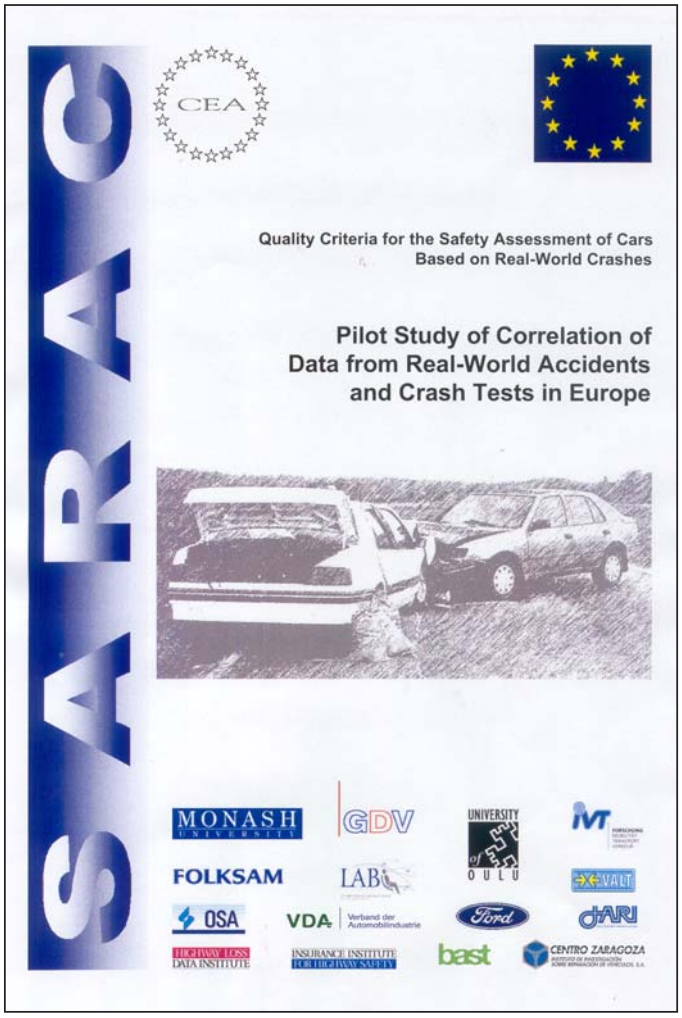
The first Intelligent seat belt reminders were reported on in November 2002. Initially, some systems covered only the driver's seat, with the front seat passenger being covered later. By 2004, Intelligent Seat Belt Reminders were becoming more common place and in June, the Volvo S40 was the first car seen with an intelligent seat belt reminder for all seats in the car.

Electronic Stability Control

Following on from its successes with Secondary Safety, Euro NCAP has now started to extend its concerns to Primary Safety. Much new technology is now aimed at reducing the likelihood of an accident happening or reducing its severity. Currently, it is unclear how effective many of these primary safety features are in reducing road accident occurrence and Euro NCAP is reluctant to endorse systems before they are proven. An exception is Electronic Stability Control (ESC), increasingly, research from different parts of the world is showing that ESC is effective in helping to prevent certain types of accidents. Consequently, in June 2005, Euro NCAP took the unusual step of giving a strong recommendation to consumers that they should specify ESC on any new car purchase. Currently, Euro NCAP is unable to make valid comparative tests of such systems, however it is believed that all currently available systems provide similar capabilities.

The Effectiveness of Euro NCAP

Although the Euro NCAP ratings have been seen to improve over time, the only real prove of Euro NCAP's effectiveness relies on the analysis of accident data. Euro NCAP is not in a position to carry out such analyses itself. Indeed, its own analyses might be open to accusations of bias. Fortunately, a number of analyses have been carried out by others and these have shown the effect of improvements in vehicle safety, many of which have been influenced by Euro NCAP.



Accident research confirms the effectiveness of Euro NCAP

In September 2000, SNRA and Monash University presented an analysis to the IRCOBI Conference. It was reported that "cars with three or four stars are approximately 30% safer, compared to two star cars or cars without an Euro NCAP score, in car to car collisions." Data was also provided which showed that the predicted relative risk of severe or fatal injury was reduced by 12%, for each increase in Euro NCAP star rating.

In October 2001, a Monash University report for SARAC, funded by the European Commission, reported that "the Euro NCAP star rating is able to differentiate with statistical significance both the average crashworthiness and injury severity based on all real crashes of vehicles in star rating categories 1,2 and 4" and "The average crashworthiness and injury severity of vehicles with overall Euro NCAP star rating 3 is almost able to be differentiated from that of vehicles in star categories 2 and 4 with statistical significance. The lack of statistical significance in this category is most likely due to insufficient number of vehicle models"

Further evidence of the effectiveness of Secondary Safety improvements were reported in the journal Accident Analysis & Prevention. It was reported that, for the UK in 1998, the number of killed and seriously injured car occupants was at least 19.7% lower than would have been expected if secondary safety had been as at 1980. Further it reported that "This figure relates to all cars on the road in 1998, and rises to 33% when confined to the most modern cars (those which were first registered in 1998)."

More recently, in August 2005, the benefits of Intelligent Seat Belt Reminders have been shown in a report from Folksam insurance. They reported that "as many as 99 percent of drivers with approved seatbelt reminder systems drive with their belts fastened, while only 82 percent of drivers without reminder systems do so" and "if we could raise seatbelt use to the level shown in our Swedish study, over 7000 lives could be saved each year on European roads."

Great interest is shown at public exhibitions of the cars - Wenceslas Square, Prague (2004)

The Launches

From the beginning of Euro NCAP, the latest test results have usually been released to the media at press conferences. These press conferences have been accompanied by an exhibition of the tested cars. In September 2000, the exhibition of cars was available for the public to see, outside La Defense, in Paris. This was the forerunner of other public exhibitions of tested cars, in such places as Barcelona, Rome, London, Athens, Prague and Stockholm.

THE EURO NCAP TESTS

Frontal offset deformable barrier test at 64 km/h

Intrusion of unstable passenger compartment allows the occupant to impact the interior

Head protection is compromised when the head slides off the airbag

injuries, for restrained adult car occupants. The test speed of 64 km/h represents a car to car collision with each car travelling at around 55 km/h. The difference in speed is due to the energy absorbed by the deformable face. Accident research has shown that this impact speed covers a significant proportion of serious and fatal accidents.

By preventing intrusion, the chances of the occupant impacting the car's interior is minimised providing space remaining for the restraint system to operate effectively. The reduction in passenger compartment intrusion is the most visible effect of Euro NCAP's influence.

Steering wheel mounted airbags form an important part of the driver's restraint system. Euro NCAP has encouraged designs where the driver's head is given stable support from the airbag and where the head does not "bottom it out."

Frontal Impact Protection

Each car tested is subjected to an offset impact into an immovable block fitted with a deformable aluminium honeycomb face. This impact is intended to represent the most frequent type of road crash, resulting in serious or fatal injury. It simulates one car having a frontal impact with another car of similar mass. As most frontal crashes involve only part of the car's front, the test is offset to replicate a half width impact between two cars. In the test, this is replicated by having 40 percent of the car impact the barrier. The barrier face is deformable to represent the deformable nature of the cars. This test is a severe test of the car's ability to survive the impact without suffering passenger compartment intrusion. Contact between the occupant and intruding parts of the passenger compartment is the main cause of serious and fatal

Impact with the steering wheel poses a serious risk to the driver

For a restrained occupant, the deceleration forces, generated in the crash, are transmitted to the occupant through the restraint system. Euro NCAP has encouraged the adoption of seat belt pretentioners, load limiters and dual stage airbags, to help attenuate the forces transmitted to the occupant. It has also helped to avoid situations where the chest is directly loaded by the steering wheel.

Prevention of footwell intrusion and control of pedal movement can help to protect the feet and ankles

In most cars, the restraint system is unable to prevent the knees of the front seat occupants from impacting the facia. Euro NCAP has encouraged the removal of hazardous structures from the areas that the knees can impact. High forces on the knee can cause injury to the knee itself and can be transmitted up the thigh to the hip joint and pelvis. These load bearing parts of the skeleton are susceptible to severe, long term, disabling injuries.

With current car designs, there is no possibility of preventing contact between the occupants' feet and the footwell. In order to minimise injuries, Euro NCAP has encouraged intrusion reduction of the footwell and greater control of foot pedal displacement.

Side Impact Protection

The second most important crash configuration is car to car side impact. Euro NCAP simulates this type of crash by having a mobile deformable barrier (MDB) impact the driver's door at 50 km/h. The injury protection is assessed by a side impact test dummy, in the driver's seat.

Although it is difficult to judge the level of protection provided from the extent of intrusion, control of how the car side intrudes is important. Through the programme, Euro NCAP has seen large improvements in side impact performance. The provision of side impact airbags has helped. It is now normal for the cars tested by Euro NCAP to be fitted with side impact airbags.

Side impact barrier test assesses protection, when hit by another car

Pole test assesses the effectiveness of side impact head protection airbags

Side Impact Head Protection

In side impact accidents, the head is the most frequently seriously injured body region. The MDB test provides little incentive to improve head protection. To address this issue, Euro NCAP adopted a low speed pole test, this provided a means of assessing the newly emerging head protecting side airbags. The pole test is carried out at 29 km/h and although it is a severe test of head protection devices, it does not represent the more severe impacts that commonly occur when cars hit poles at the roadside. The test is simply able to assess the performance of such devices, within their current range of capability.

Child Occupant Protection

Child protection is assessed in the frontal and side impact barrier tests

In the frontal and side impact barrier tests, dummies representing 1 1/2 and 3 year old children are placed in the rear of the car in the type of child restraint, recommended by the car manufacturer.

Euro NCAP has encouraged manufacturers to take responsibility for protecting children and to provide suitable facilities for the fitment of child restraints. Many child restraint users fail to attach the child restraint securely to the car and this compromises the protection afforded to the children. Euro NCAP has encouraged improved designs and the fitment of ISOFIX mounts and child restraints. ISOFIX provides a much more secure method of attaching the child restraint to the car, provided that additional provision is made to prevent rotation of the child restraint, due to seat cushion compression and rebound. As a consequence, Euro NCAP has seen improved designs, where the child is less likely to strike the car's interior, whilst at the same time experiencing reduced forces from the restraint system.

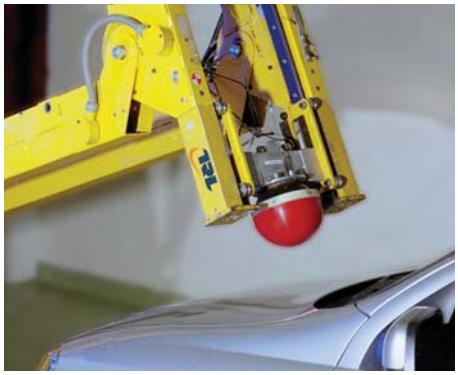
Legform tests are carried out to assess the bumper area

Pedestrian Protection

It is very difficult to assess pedestrian protection using a full dummy. Althought it would be possible to control the point of impact of the bumper against the dummy's leg, it is impossible to control where the dummy's head will subsequently strike. To avoid this problem, individual component tests are used.

A Legform test assesses the protection afforded to the lower leg by the bumper, an Upper Legform assesses the leading edge of the bonnet and child and adult Headforms are used to assess the bonnet top area.

Upper Legform tests are used to assess the bonnet leading edge



Child and Adult Headform tests assess the bonnet top area

Protection can be improved with pedestrian friendly bumpers, which deform when they hit a pedestrian's leg. Protection is improved if the leg is impacted low down, away from the knee, and if the forces are spread over a longer length of leg. For the leading edge of the bonnet, improvements can result from the repositioning of stiff structures. To protect the head, the bonnet top area needs to be able to deflect. It is important that sufficient clearance is provided above the stiff structures beneath, which would stop this deflection.

Awards to Euro NCAP

Euro NCAP's greatest reward comes from the reduction in road accident casualties. However, others have seen the importance of Euro NCAP's influence and have recognised it. Euro NCAP has received the following awards in recognition of its work.

1998 Autocar Safety Award

1999 FT Global Automotive Award

2000 IMI Gold Medal

2001 Quattroruote Special Award for Safety

2003 Prince Michael International Award

2003 Prince Michael Premier Award

2005 AutoBest Safetybest Award

Euro NCAP Members

Euro NCAP can only exist because of the support provided by its members. They provide financial support, control Euro NCAP's activities and ensure its independence. Because of their status, they also help to ensure Euro NCAP's credibility.

The Euro NCAP Members are:

National Governments

France, Germany, The Netherlands, Sweden and United Kingdom

Provincial Governments

Catalonia

Motoring Organisations

ADAC, FIA Foundation

Consumer Organisations

ICRT

Insurers

Thatcham

Test Laboratories

Six organisations have been approved by Euro NCAP to be responsible for its test programme. In each case, they have had a close relationship with one or more of the members and most are experienced in vehicle safety research. They are commissioned by Euro NCAP to carry out the tests on individual car models.

The laboratories approved to be responsible for testing are:

ADAC	Germany
BASt	Germany
IDIADA	Spain
TNO	The Netherlands
TRL	United Kingdom
UTAC	France

THE EUROPEAN NEW CAR ASSESSMENT PROGRAMME PARTNERSHIP
2 PLACE DU LUXEMBOURG, B - 1050 BRUXELLES
☎ +32 2 400 77 40
www.euroncap.com

BUNDESMINISTERIUM FÜR VERKEHR, BAU- UND WOHNUNGSWESEN
ROBERT-SCHUMAN-PLATZ 1
D - 53175 BONN
☎ +49 2204 43 640 (BASt)
www.bmvbw.de

DUTCH MINISTRY OF TRANSPORT, PUBLIC WORKS AND WATER MANAGEMENT
1-6 PLESMANWEG P.O. BOX 20901
NL - 2500 EX THE HAGUE
☎ +31 70 351 61 71
www.verkeerenwaterstaat.nl

FIA FOUNDATION FOR THE AUTOMOBILE AND SOCIETY
60 TRAFALGAR SQUARE
GB - LONDON WC2N 5DS
☎ +44 207 930 3882
www.fiafoundation.com

INTERNATIONAL CONSUMER RESEARCH AND TESTING (ICRT)
30 ANGEL GATE, CITY ROAD
GB - LONDON EC1V 2PT
☎ +44 207 713 7325
www.international-testing.org

VÄGVERKET
RÖDA VÄGEN 1
S - 781 87 BORLÄNGE
☎ +46 243 75000
www.vv.se

DEPARTMENT FOR TRANSPORT
GREAT MINSTER HOUSE
76 MARSHAM STREET
GB - LONDON SW1P 4DR
☎ +44 207 944 2085
www.dft.gov.uk

ALLGEMEINER DEUTSCHER AUTOMOBIL-CLUB e.V. (ADAC)
8 AM WESTPARK
D - 81373 MÜNCHEN
☎ +49 89 76760
www.adac.de

GENERALITAT DE CATALUNYA
DEPARTAMENT DE TREBALL I INDÚSTRIA
SEPÚLVEDA 148
E - 08011 BARCELONA
☎ +34 932 285 757
www.gencat.net/treball

MINISTERE DE L'EQUIPEMENT, DES TRANSPORTS ET DU LOGEMENT
ARCHE DE LA DEFENSE
PAROI SUD
F - 92055 LA DEFENSE CEDEX
☎ +33 1 40 81 81 28

THATCHAM
COLTHROP WAY
GB - BERKSHIRE RG19 4NR
☎ +44 1635 868855
www.thatcham.org

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