EEVC *CEVE*

Report on Recent Activities 1996

Rapport sur les Evènements Récents 1996

European Experimental Vehicle Commitee
Comité Européen sur les Véhicules Expérimentaux

THE EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE

1. INTRODUCTION

The European Experimental Vehicles Committee (EEVC) was founded in 1970 in response to the US Department of Transportation's initiative for an international programme on Experimental Safety Vehicles (ESVs). Its scope was

> **"to ensure the continuing exchange of information between the participating governments, and their collaboration to achieve the best use of their available resources in response to the United States' invitation to participate in the development of experimental safety vehicles".**

The first chairman of EEVC, Mr Harold Taylor of the UK Transport and Road Research Laboratory, described the tasks at the sixth ESV Conference in 1976 as:

- **to maintain liaison between European national research and development activities, and**
- **to provide a forum for clarifying views on the various technical options and on the response that should be made to various international initiatives.**

Early FIAT experimental safety vehicle

The ESV programme is no longer focused on the specific development of experimental vehicles but on the broader field of improving the safety of vehicles on the road, as indicated by the change of name to Enhanced Safety Vehicle. Nevertheless, the general objectives and tasks of the EEVC remain much the same today.

The governments of **France, Germany, Italy, the Netherlands, Spain, Sweden and the United Kingdom** are represented on the EEVC. Each government can nominate two members, who are selected for their technical expertise, one as an authority on the research and the other to advise on governmental needs and application: they are not there as representatives of the particular policy or commercial interests of their national governments, but to ensure that EEVC research is of high quality and well-suited to practical application. Representatives from the European Commission attend as observers.

Car-to-car impact, BASt

Truck front underrun, VTI

Over these first twenty five years, the EEVC has set up international working groups to examine the following issues:

- Accident statistics
- Human tolerance and biomechanics
- Priorities for safer vehicles
- Side impact protection and the development of the EUROSID dummy
- Pedestrian protection
- Cycle and light powered two-wheeler accidents
- Heavy goods vehicle safety
- Motorcycle safety
- Front impact protection
- Frontal impact dummy development

Pedestrian impactor test, TNO

Experimental motorcycle airbag, TRL

Side impact test, INTA

Underrun test, INRETS

The EEVC has the full support of participating governments and their industries, and is able to draw on the best available expertise in all the safety fields considered. In addition to scientific and technical experts, the EEVC includes appropriate input from administrators and legislators.The reports of the EEVC are published mainly in the proceedings of the ESV Conferences, but a wide range of reports is available directly from the EEVC (see list at Appendix 2).

The technical advice and the experience gathered by the EEVC is used to support the negotiations of the European Commission and of the UN Economic Commission for Europe, in Working Party 29 on the construction of vehicles, and of other international bodies responsible for harmonisation of standards or international legislation.

Cooperation between the research and development activities of the EEVC and those of the National Highways and Traffic Safety Administration of the USA is very well established, and the findings are also transmitted to Australia, Canada and Japan, and to the international scientific community in general. The recent work of the EEVC is described in more detail in this booklet.

The EEVC provides the link between Government, Research and Development, Industry, Administration and Regulation in Europe in the quest for safer road vehicles.

2. BRIEF HISTORY OF THE EEVC

On the 14th and 15th of October 1970, government technical representatives from the Federal Republic of Germany, France, Italy, the United Kingdom and the USA met to discuss the invitation sent by the USA to European Governments to participate in the development of Experimental Safety Vehicles (ESVs). Responding to increasing public concern about rising road accident casualties, the USA had already instituted a programme designed to develop ESVs to demonstrate the practicability of making vehicles safer, but it wished to initiate a wider collaboration, and this meeting agreed to set up a "European Intergovernmental Technical Committee on the Development of Experimental Safety Vehicles" to parallel the US initiative. As indicated in the terms of reference (see Appendix 1), the participants decided to extend the aims of the Committee beyond development of ESVs to a wider coordination of research programmes, and to consider the possible application of research results to regulation.

Although the Committee was constituted of technical representatives from government departments and laboratories, it agreed on the importance of consulting experts from industry where appropriate. The first official meeting of this group was held on the 4-5th of February 1971 in Rome. The meeting was attended by the Federal Republic of Germany, France, Italy, the United Kingdom and, as observers, the Netherlands and Sweden. They later became full members.

The Committee decided to take its present title of the "European Experimental Vehicle Committee" during its third meeting on 21-22 October 1971, and at the same time to extend the terms of reference to embrace environmental aspects such as pollution control and noise reduction, as well as the safety of road vehicles, though it has so far concentrated its efforts on safety.

It was decided to invite observers from the European Commission to the EEVC Committee meetings, and to hold separate meetings with American delegates from time to time.

3. THE ROLE OF THE EEVC

The work of the EEVC is pursued in a number of technical Working Groups, directed and overseen by the Steering Committee. The Steering Committee is composed of representatives nominated by the Governments of member countries. Each Government is entitled to nominate two members:

i) **One member from the appropriate area of Government, who should have a comprehensive technical understanding of the issues relevant to vehicle research, and an appreciation of the needs of vehicle safety policy makers;**

ii) **One member from a governmental research establishment involved in vehicles research, with a good knowledge of the execution of vehicles research on behalf of Government. In the event that the country does not operate a Government-owned vehicles research establishment, the Government will be entitled to nominate a technically-knowledgeable representative from a non-governmental research establishment or company.**

The EEVC places emphasis on both types of representative, because it is important that its research programme should be shaped and informed by the need to apply its findings by the most appropriate routes. Experience has shown that the involvement of members from the policy areas of Government can provide a helpful focus for this. It is not the role of the EEVC to develop or draft vehicle regulations, but to act as technical adviser to the regulatory bodies, where this activity has been invited or requested, by:

- **identifying what progress in vehicle safety and other vehicle matters seems possible;**
- **carrying out research to determine the best way forward;**
- **demonstrating its practicality, and developing appropriate test procedures as necessary.**

This essential information can then be transmitted to the regulatory bodies, and to member governments, to take such action as seems most appropriate. It is important that the EEVC is able to pursue its work objectively and impartially, free from any sort of political pressure. Thus the policy-based members are there merely to advise on relevance and application, and not to press national points of view. This mixture of expertise has worked very well in the past, and the conclusions of the various EEVC Working Groups have been based on an objective technical and scientific consensus, to provide unbiassed advice.

The Steering Committee is presently chaired by Dr Bernd Friedel of BASt, while the Technical Secretary is Dr Dominique Cesari of INRETS. The Working Groups are chaired by experts drawn from the member research establishments, who report to the Steering Committee periodically. The groups consist of technical experts nominated by member countries. Policy representatives do not serve on the Working Groups.

Since the work of the EEVC must be fully practical, it is important to involve the knowledge and expertise of industry, and the national representatives on the Working Groups may invite participation by experts from industry. These experts have observer status only, since it is essential to ensure that the research programme cannot be unduly influenced by the commercial concerns of industry, but in practice the work and the conclusions drawn are agreed by consensus and voting rights are rarely used. Similarly, in the interests of international harmonization, the Steering Committee may decide to invite observers from those other countries which play important roles in international regulation or which can offer relevant information. This ensures that, wherever possible, the European vehicles research programmes are aware of developments in other countries, so that unnecessary duplication or incompatibility can be avoided. As noted below, an excellent degree of collaboration has been achieved.

4. THE EEVC AND THE COMMISSION OF THE EUROPEAN UNION

The European Union is responsible for regulations governing road vehicles in Europe, and the most important role of the EEVC is to provide appropriate technical advice on which that regulation can be based. Consequently, the European Commission has a very direct interest in the work of the EEVC, and has participated in the EEVC programme from its inception. The early studies of the EEVC showed the need for extensive research in the field of impact biomechanics if vehicle crash protection were to be improved, and in 1978 the Commission began funding the EEVC in a coordinated research programme in this field. The findings of this research were published in 1983, but the work is still recognised as an authoritative reference. Since then the Commission, in the form of Directorates-General III and VII, has funded work to develop and assess improved test procedures for side-impact protection, pedestrian protection, and frontal-impact protection. This active involvement of the Commission is important to the success of the EEVC, not simply in terms of the financial support in an area of research which is unavoidably expensive, but perhaps more importantly in the need to establish a close working relationship with the body responsible for applying the results of the research.

5. THE EEVC OUTSIDE EUROPE

Vehicle manufacturing is a global industry, and it is important that the EEVC should be fully aware of research undertaken elsewhere in the world in the search for better road vehicles. In the interests of harmonization it is especially important that it should exchange views and information with the National Highways and Traffic Safety Administration of the USA, and with Japan, as major vehicle-producing countries. The EEVC has exchanged data and knowledge with NHTSA concerning side impact testing and dummies, and pedestrian protection, and the USA, Japan, Australia and Canada send observers to the EEVC Working Groups concerned with frontal impact protection and frontal dummy development.

Dr Freidel receiving an ESV award, 1985: Mrs Dole, US Secretary of State for Transportation is on the right, and Diane Steed, Administrator of the NHTSA, on the left

6. PAST ACTIVITIES OF THE EEVC

During the past 25 years, the EEVC has contributed widely to the improvement of technical knowledge in the field of traffic accident prevention and protection. The main contributions from the EEVC have been via Working Groups dealing with crash protection. The first three Working Groups created at the time the EEVC was founded had the task of "making quick assessments of present knowledge of the accident situation and the prospects for safer cars". Later Working Groups were set up to make longer and more detailed studies of those issues considered especially in need of research.

The activities of each of these Working Groups are described briefly below, and their publications are listed in Appendix 2. The work of the more recent Working Groups is described in more detail in the next section.

Working Group 1: Accident Data

WG 1 reviewed the sources of accident data available in Europe and commented on how these could best be developed to further the aims of car safety. This permitted the definition and classification of accident problems in order of importance. Recommendations for the improvement of accident studies were also made.

INRETS: Accident investigation

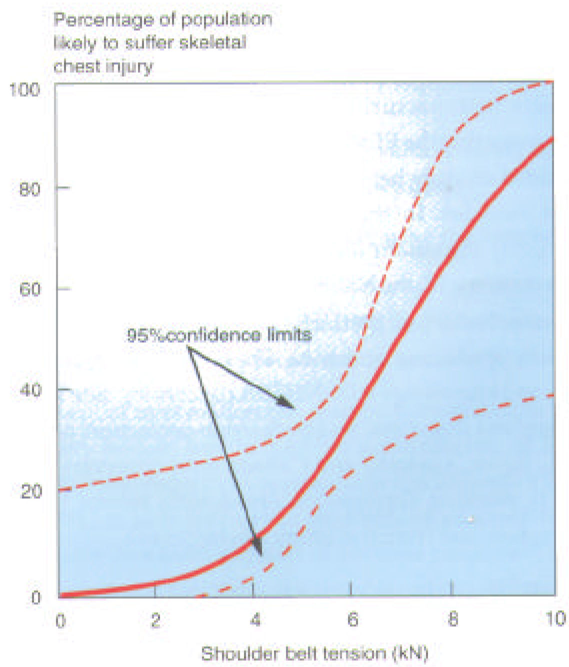
TRL: Early safety car

Working Group 2: Potential Safety Improvements

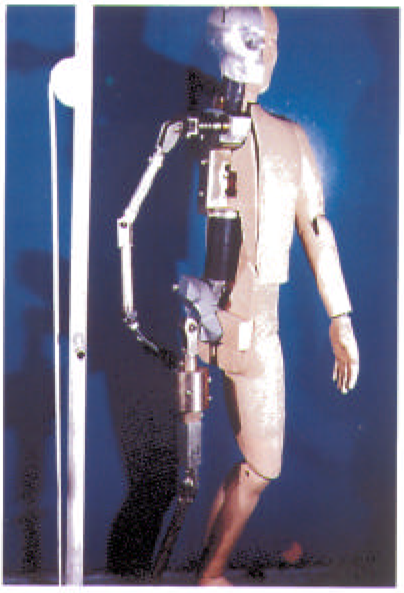
WG 2 examined the information made available by WG 1, and assessed realistic safety requirements, compared their priorities and identified scope for improvement.

Working Group 3: Human Tolerance Levels and Occupant Protection Evaluation Techniques

WG 3 had the task of reviewing the technical problems involved in assessing occupant safety by impact test procedures. These studies included an assessment of currently available human injury tolerance limits, anthropomorphic dummies, and test techniques, together with recommendations for future research.



ISO human tolerance corridor



INRETS: Early anthropometric dummy

Working Group 4: Biomechanics

This Group extended the work of WG3 to identify the human tolerance parameters which need to be considered in impact testing, gaps in current knowledge, and application to the development of better front and side impact protection.

Working Group 5: Impact Test Procedures

On the basis of the findings of WG3 and WG4, this Working Group identified the sort of test procedures which could be expected to produce an improved level of occupant protection, for both front and side impacts.

TRL: Full-scale impact test

The final reports of WGs 1 to 5 allowed the EEVC to define, on the basis of European experience and technical knowledge, a sufficiently common view to provide an assessment of the future needs of car safety in Europe. Following this basic assessment, in the mid-1970s the EEVC turned its attention primarily to the fields of car occupant protection in side impact, and to pedestrian protection by improved design of the fronts of cars.

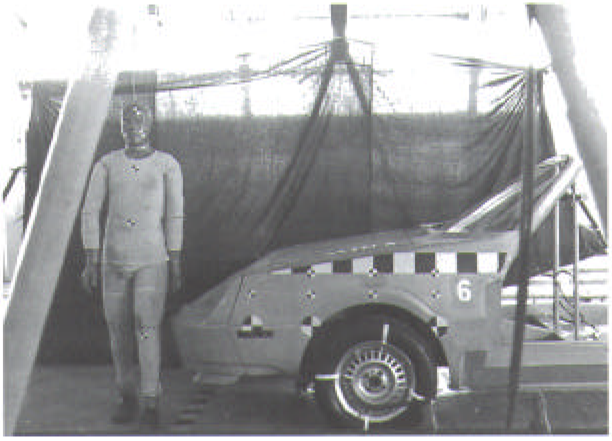
INRETS: Car-to-car side impact test

Working Group 6: Structures for Improved Side Impact Protection in Europe

This Working Group expanded on studies of side impact done within WG5 to formulate a full-scale test procedure, in conjunction with an ad hoc group which was set up to consider the requirements for an anthropometric test dummy to indicate likely injury levels in a side impact.

Working Group 7: Pedestrian Injury Accidents

The importance of pedestrian injuries had already been identified in the work of WG1, and this Working Group further analysed the available accident data to identify the most productive approaches to reducing this toll. An ad hoc group was constituted to consider the influence of car design on the types of injury caused to pedestrians.



BASt: Dummy pedestrian impact test

FIAT: Car/cyclist impact test

Working Group 8: Cycle and Light-Powered Two-Wheeler Accidents

This study of two-wheelers was undertaken in parallel with the pedestrian studies of WG7 because of the prevalence of car/cycle collisions in the Netherlands especially. It examined the types of accident which occurred and reviewed the counter-measures which might be taken.

Much of the work done in these earlier Working Groups has fed into the programmes of more recent Groups:

Working Group 9: Side Impact Test Procedure

Working Group 10: Pedestrian Protection

Working Group 11: Frontal Impact Test Procedure

Working Group 12: Frontal Impact Dummy Development

Working Group 13: Side Impact Protection

Ad Hoc Group on Motorcycle Safety

Ad Hoc Group on Front Underrun Protection of Trucks

Working Group 14: Energy Absorbing Truck Front Underrun.

The work of these more recent groups is described in the next section.

7. RECENT EEVC ACTIVITIES

Typically in Europe, car occupants account for about half of all road accident deaths and serious injuries, while pedestrians account for a further twenty percent. Of the car occupant casualties, a half to two thirds occur in frontal collisions, while a quarter to a third happen in side impacts. It is obviously sensible to take these three groups of casualties, car occupants in side and frontal collisions, and pedestrians struck by motor vehicles, as the priorities for vehicle safety research.

7.1 SIDE IMPACT PROTECTION

Although frontal collisions cause more casualties than side impacts, the European Union already had a Directive requiring vehicles to meet a certain standard of structural performance in a 50 kph impact into a rigid block, while there was no such Directive to cover side impact protection, so the EEVC decided to tackle this problem first. Because the side of a car is necessarily thin, it is obviously more difficult to provide energy absorption and protection against intrusion from side impacts than from frontal impacts. As long ago as the early 1970s, EEVC saw the need to investigate what improvements might be achieved (1), and has since organised a series of Working Groups to study various aspects of side impact.

In order to quantify the level of protection a particular design of car offers, it is first necessary to design a test procedure to simulate the most important aspects of real side-impact accidents, so that the likely injuries to the occupants can be predicted in a reliable, repeatable and systematic way. An essential part of the test in this case was to design an anthropomorphic dummy to measure all the forces which are likely to cause injury to a real occupant, since no suitable dummy existed for measuring the effects of impacts from the side.

The EEVC, therefore, had to organise a major programme of research and development within its constituent research establishments. Working Group 9 on Side Impact Test Procedure addressed three separate but overlapping topics:

i) Development of a test procedure aimed at assessing the most important aspects of protection in real side accidents;

ii) Development of a Side Impact Dummy as a realistic indicator of likely injury;

iii) Examination of the side impact performance of current vehicle models, and identification of practical ways of improving protection, to provide information on an acceptable pass mark for the test.

(i) The test procedure

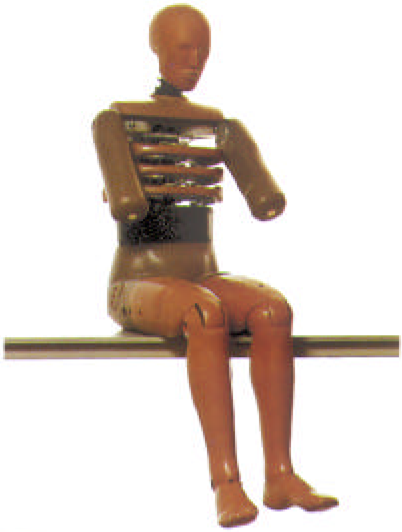
In a side impact the car occupant is very close to the point of impact, and collapse of the vehicle side and infliction of injuries happens very quickly: all the important injury-causing mechanisms are complete within 50 msec. The details of the structural collapse and interaction with the occupants are very complex, and although sub-system testing and mathematical modelling have contributed to the development of the test procedure, EEVC concluded that there was no satisfactory alternative to a full-scale impact test.

BASt: Mobile side impact barrier

The procedure adopted (2) was to run a mobile barrier, representing the 'bullet' vehicle, at 50 kph directly into the side of the vehicle to be tested, centred on the vehicle 'R' point. The extra complexity of a crabwise impact, as in the US test, was rejected since it did not provide useful additional information. The front of the mobile barrier, made of expanded plastic blocks or aluminium honeycomb in different versions, was of a stiffness which varied across the barrier face in a way which represented the front of a 'typical' European car. The dimensions and weight of the barrier are somewhat smaller than for the US test procedure as befits the difference between average European and American cars, but more importantly the EEVC barrier face is also less stiff. This provides more realistic intrusion of the barrier into the door, and prevents a vehicle from passing the test simply by virtue of strengthened sills and A and B pillars, a design approach which does not necessarily provide protection from injury in real accidents.

ii) The side impact dummy

The European Side Impact Dummy, EUROSID, stemmed from a very productive collaborative project between five European research institutes (3,4). EUROSID uses head and legs from standard Hybrid dummies, but in side impacts the performance of the thorax and pelvis is crucial, and the dummy's trunk had to be designed from first principles. TRL took responsibility for the thorax, INRETS for the pelvis, and TNO for the abdomen and the Association Peugeot-Renault for the neck, while BASt and Ford have contributed to the assessment and development programme.



EUROSID side impact dummy

It was important to ensure that EUROSID's response to impact agreed with what was known about biomechanical measurements on cadavers and volunteers, though it is obviously not possible to construct a practical dummy which has a humanlike response in all possible characteristics, and it is necessary to concentrate on those aspects of biofidelity which are considered most important in real side-impact injury mechanisms. Indeed, the assessment of the Prototype version of EUROSID identified weaknesses in some of the accepted information and practices and these were overcome in the production version, EUROSID I. Overall, EUROSID I has been shown to be adequately biofidelic, robust, repeatable and reproducible, and to be able to distinguish between different levels of side-impact protection (5,6)

iii) Side-impact protection

The Working Group has applied the EEVC Side Impact Test Procedure to many different models of car, with a variety of sizes and constructions. It has also compared the effect of the Mobile Deformable Barrier with that of different bullet cars and with the NHTSA test procedure (7,8,9,10).

It is clear that the level of side-impact protection which can be provided by careful design of the side of the car can be improved substantially, and that this is not simply a matter of stiffening the side to resist intrusion, or of padding the interior. Both can help, but injuries are also greatly affected by the way in which the side of the vehicle collapses: thus improving side-impact protection is not necessarily a matter of substantially increased production costs, but rather one of a better understanding of the mechanisms involved and appropriate design.

TNO: EEVC side impact test

The EEVC Test Procedure was finalised and passed to the European ERGA Committee on Passive Safety in June 1989. There has been considerable delay in implementing the procedure following industry's proposals for an alternative test based on a quasi-static crush test and simple computer modelling. The EEVC was involved in comparison of the alternative procedures, but the modelling option was found to be unsatisfactory. The EEVC Test Procedure, with minor modifications, has also been accepted by the UN-ECE WP29 and will become effective at the end of 1995, though there is controversy over WP29's agreement to set the barrier height below the EEVC recommendation, which makes the test less severe. The European Commission is on the point of incorporating the test in a Directive, but has now agreed to use the EEVC's recommendation for barrier height. The International Standards Organisation has also written a very similar test procedure, and has passed a resolution that EUROSID1 is one of two dummies suitable for use in a side-impact test procedure.

While the full scale side impact test evaluates the injury risk to the four major body areas that are seriously injured in side impacts (head, thorax, abdomen and pelvis), the head can contact a wide area in side impacts. Since head injuries account for a large proportion of serious injuries (over 40 percent of AIS 4) and fatalities (34 percent) in side impact accidents, EEVC Working Group 13 is developing a simple head impact test procedure to assess head injury protection in lateral impacts.

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7.2 PEDESTRIAN PROTECTION

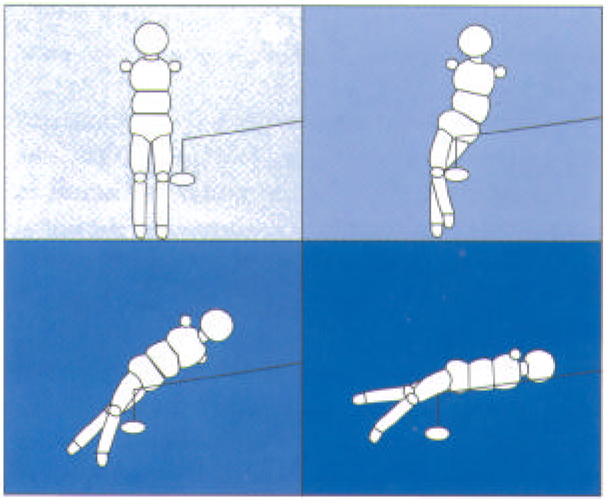
Pedestrian casualties contain a disproportionately large number of elderly people and children, but pedestrians of any age are obviously very vulnerable when struck by a vehicle. Since it is not possible to provide the pedestrian directly with any useful protection, it might be thought that little could be done to reduce these casualties, and there is certainly little chance of avoiding serious injury or death in a high-speed collision. But 80 per cent of all car/pedestrian collisions, and 25 per cent of fatalities, occur at impact speeds of 40 kph or less (1). At these lower speeds, there is much which can be done to make the front of a car less injurious.

The EEVC set up **Working Group 10 on Pedestrian Protection** in 1988 to examine this problem and to develop a test procedure to assess the injuriousness of any given car model. This work was requested, and funded, by the European Commission for consideration as an EU Directive. Again, the work has been a fully collaborative research exercise between APR, BASt, INRETS, TNO and TRL.

Pedestrian injuries are most frequently to the legs, pelvis and head. The car bumper strikes the lower legs or knees, the bonnet leading edge strikes the upper legs or pelvis, or in the case of children the abdomen, and the head of the pedestrian tends to swing down onto the bonnet top, the wings, or further back onto the scuttle or windscreen in the case of taller pedestrians, shorter bonnets or higher impact speeds.

The EEVC Working Group has examined a large number of experimental impacts between whole cars, and car front sections on a test rig, and specially-developed instrumented dummies to represent both adult pedestrians and children (2,3,4). Computer simulation using the MADYMO package has also been used to aid understanding of the mechanisms involved.

To minimise injury, particularly to the knee joint, the bumper should spread the load of the initial contact along the length of the lower leg, avoiding any concentration on the knees, and its surface should deform to reduce the load. A deep bumper starts to accelerate the pedestrian's leg, breaking the contact with the ground.



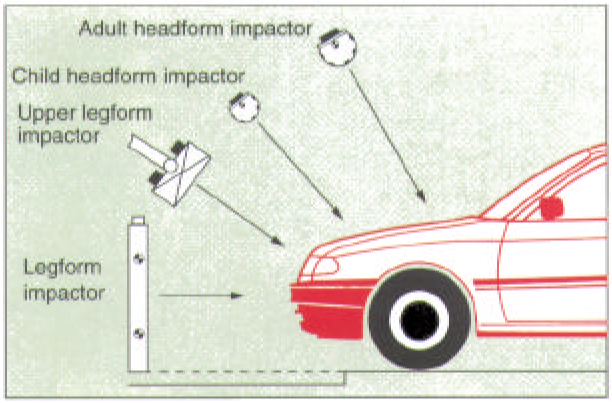
MADYMO modelling of pedestrian impact

The bonnet leading edge, and as far as possible the tops of the wings and the corners of the car, need to be deformable, to crumple and so absorb energy, without retaining strong, stiff parts such as bonnet latches close to the edge.

Depending on the height of the pedestrian, speed of impact and bonnet length, the head may strike the bonnet top. The head injuries this causes can often be fatal, and to minimise the risk of this the bonnet should be designed to collapse in a controlled way, absorbing energy, and without the many hard components in the engine compartment lying so high that they prevent the required amount of collapse.

To avoid the expense and complexity of a full-scale impact test, the EEVC Working Group has developed a test of each of these three sub-systems: the bumper assembly, the bonnet leading edge, and the bonnet top (3,4). These are struck by impactors designed to assess the protection afforded to, respectively, the legs, pelvis, and head of both child and adult pedestrians. The tests aim to ensure that the car front will minimise injuries, but without dictating styling. Since the shape of the front determines the pedestrian's trajectory, however, the required impact speeds for the test impactors are determined by the geometry of the cars in question. The developed test procedure was submitted to the European Commission at the end of 1990. The sub-system tests are already being used to help in the design of future, more pedestrian-friendly, car models.

Legform impactor	- simulates impact of the leg to the bumper
Upper legform impactor	- simulates impact of the femur to the bonnet leading edge
Child headform impactor	- simulates impact of the child head to the forward section of the bonnet top
Adult headform impactor	- simulates impact of the adult head to the rearward section of the bonnet top



The three EEVC pedestrian impactors

At higher speeds the heads of pedestrians are likely to be seriously injured by the hard structure surrounding the windscreen, and attention needs to be paid to this. But the improvements in car front and bonnet top which will be required by the EEVC Test Procedure will achieve a substantial reduction in pedestrian injury. The EEVC Working Group estimates that they are likely to reduce pedestrian fatalities by 6 to 10 per cent, and serious injuries by up to 30 per cent (5).

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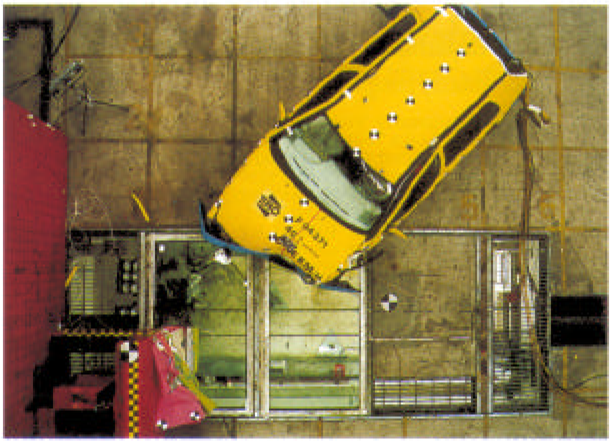
7.3 FRONTAL IMPACT

With test procedures already developed to improve protection for pedestrians and for car occupants in side impacts, the EEVC turned its attention to frontal collisions again. This type of accident accounts for the majority of vehicle occupant casualties, and there is concern that the existing ECE Regulation 33, which requires a full-width, 90 degree impact into a rigid block, is not sufficiently representative of real accidents to ensure that the protection provided by current car models is as good as it could be. Frontal impact accidents include a wide range of impact overlap and into a variety of objects, although the majority are car to car. Clearly one test cannot represent all of these conditions, but the EEVC takes the view that an appropriate test can be designed which will result in car designs that give good protection in as wide a range of the more common serious accidents as practicable. Accident studies and preliminary testing indicated that the appropriate test procedure would be a partial offset impact into a deformable structure.

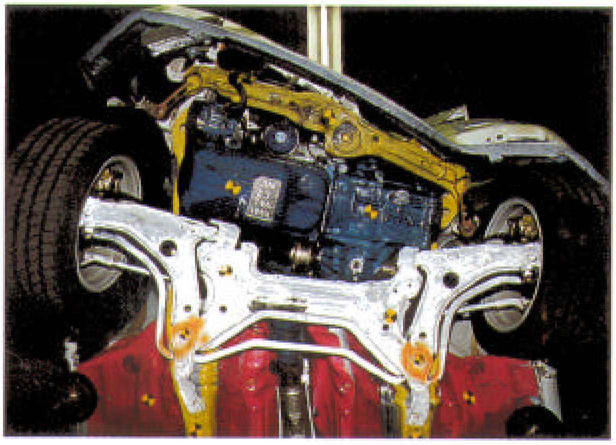


TNO: EEVC offset deformable frontal impact test

The EEVC considers it important that in future research projects which might give rise to test procedures there is collaboration between Europe and America at an early stage, so that as much harmonization as possible can be achieved between regulations on each side of the Atlantic. Since the National Highway and Traffic Safety Administration (NHTSA) of the USA has already begun to consider development of a new frontal impact dummy, EEVC has set up two new Working Groups, one concerned with dummy development and the other to examine frontal protection requirements and possible test procedures. Both of these groups are liaising with NHTSA. In addition, government representatives from Canada, Australia and Japan are contributing to the work of these groups.

EEVC Working Group 11 on Frontal Impact Test Procedure completed a series of frontal impact tests in 1993, with the support of the EC, to determine the conditions for an offset deformable tests. A proposal for a new front impact test procedure was presented at the 1994 ESV Conference (1). The Working Group then evaluated this proposal by testing a wide range of modern vehicle designs and types. The final report was produced in autumn 1995 (2). The test procedure has already been accepted by the UN-ECE WP29 and will become effective at the end of 1995.

The European Commission has stated its intention to introduce a Directive incorporating a test based on the EEVC research, to be effective from 1998.



BASt: Underside of car after ODB frontal test

WG12 on Frontal Impact Dummy Development has commenced the collation of the requirements for a frontal impact dummy for use in Europe and has performed some tests on the prototype advanced thorax. The WG is collaborating closely with NHTSA's programme in the USA to develop an advanced dummy, and by ensuring that the dummy will be suitable for European restraint conditions and will encapsulate experience gained from European research as well as from the USA, the dummy should be applicable world-wide. The research on the advanced dummy is likely to last for several years, since this involves a great deal of experimentation and analysis of the biomechanics of human impact, but there is much to be gained and, as in most of the EEVC's work, the results will ultimately appear in the form of lives and injuries saved.

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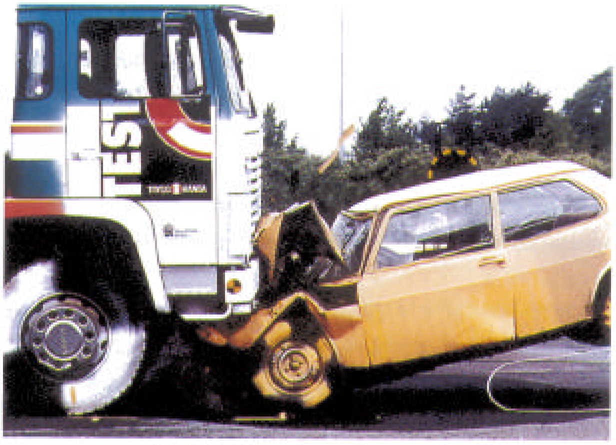
7.4 TRUCK FRONT UNDERRUN

Trucks with gross weights of more than 3.5 tonnes are involved in 25 to 30 per cent of the fatal accidents in the European Union. More than 80 per cent of those killed are car occupants, cyclists, motorcyclists and pedestrians. Almost as many car occupants are killed each year in accidents involving trucks as in car-to-car impacts and about two-thirds of these are killed when their cars collide with the fronts of trucks. In many of these front of truck impacts, the front of the car underruns the high structure of the truck which can intrude directly into the car occupant space. Detailed accident data available in many European countries shows that a front underrun protection system (FUPS), fitted to the front of the truck, would prevent many of the underrun accidents (1,2,3).

Because the EEVC recognised truck safety as an important area, an EEVC **Ad Hoc Group: Front Underrun Protection of Trucks** was established in 1991 with the objective of evaluating the potential of truck front underrun protection systems for reducing injury risks to car occupants. France, Germany, the Netherlands, Spain, Sweden and the UK were represented. The group met twice and concluded that the introduction of FUPSs would have a positive influence on road safety and that they should be introduced using a step by step approach (4,5). Firstly, a rigid FUPS should be introduced, followed by the introduction of energy-absorbing FUPSs in the future. The Ad Hoc Group advised that the further necessary research on front underrun protection in Europe should be coordinated by the EEVC.

A draft ECE Regulation for a rigid front underrun protection system for trucks with gross weights exceeding 3.5 tonnes was agreed in early 1993 and was finalised as



VTI: Truck front underrun impact test

Regulation 93 in early 1994. It is intended that an EC Directive, based on Regulation 93, should be agreed in the near future.

EEVC Working Group 14 on Energy Absorbing Truck Front Underrun was established in October 1993. Its objective is to carry out the development of a test procedure for energy-absorbing front underrun protection systems for trucks taking the recommendations of the Ad Hoc group as a basis. The project is divided into five phases and a final report is due at the end of 1996.

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7.5 MOTORCYCLE SAFETY

The EEVC set up an **Ad Hoc Group on Motorcycle Safety** to review all aspects of motorcycle safety connected with the design of the machine or the rider's clothing, but excluding matters of rider behaviour and training. The Group was unable to initiate new research, but it brought together a number of experts from research establishments, academia, and the industry, mainly from Germany and the UK, with knowledge in the many different aspects of motorcycle safety, to collate and examine existing data and knowledge, and to form a consensus, as far as possible, on how safety might be improved. The Group reported in 1993 (1), with a review covering accident and injury data, braking and handling, conspicuity, passive safety, leg protection, airbags, trajectory control, helmets and clothing, and the road environment. It is clear that the mode carries a much higher risk of injury than does an enclosed four-wheel vehicle, but the study identified a number of promising approaches which might reduce the risk of accident and provide better protection. A summary of the findings was presented at the 1994 ESV Conference (2).

TRL: Motorcyle impact test with airbag and leg protection

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APPENDIX 1

TERMS OF REFERENCE FOR THE "EUROPEAN INTERGOVERNMENTAL TECHNICAL COMMITTEE ON THE DEVELOPMENT OF EXPERIMENTAL SAFETY VEHICLES"

To ensure the continuing exchange of information between the participating governments and their collaboration to achieve the best use of their available resources in any effort they are able to mount to respond to the United States invitation to participate in the development of experimental safety vehicles:

And to pay particular regard in this matter to the following:-

> programmes of research and development during formation and execution;
>
> contracts during their stages of development and placing, progress reports;
>
> discussion of matters which stand out as of particular importance, including where appropriate consultation with experts from industry and the arrangements of visits;
>
> early identification of subjects which may be ready for regulation, or alternatively unsuitable for regulation.

And to report from time to time to the governments of the participating countries.

APPENDIX 2

PUBLICATIONS OF THE EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE

Working Group 1:

1. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 1 ON ACCIDENT DATA (1974). A review of data sources for car safety improvements. Published in: The future for car safety in Europe, Fifth ESV Conference, London, June 1974.

Working Group 2:

2. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 2 ON POTENTIAL SAFETY IMPROVEMENTS (1974). The order of priority and major requirements for safer cars for the near future. Published in: The future for car safety in Europe, Fifth ESV Conference, London, June 1974.

Working Group 3:

3. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 3 ON HUMAN TOLERANCE LEVELS AND OCCUPANT PROTECTION EVALUATION TECHNIQUES (1974). Human Tolerance levels and occupant protection evaluation techniques. Published in: The future for car safety in Europe, Fifth ESV Conference, London, June 1974.

Working Group 4:

4. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 4 ON BIOMECHANICS (1976). Report of a working group on biomechanics. Proceedings of the Sixth ESV Conference, Washington, October 1976.

5. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 4 ON BIOMECHANICS (1976). Use of Cost/Effectiveness and Cost/Benefit Studies for the Selection of Vehicle Safety Measures. Proceedings of the Sixth ESV Conference, Washington, October 1976.

6. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 4 ON BIOMECHANICS (1976). Report to the Sixth ESV Conference. Proceedings of the Sixth ESV Conference, Washington, October 1976.

Working Group 5:

7. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 5 ON IMPACT TEST PROCEDURES (1979). Impact Test Procedures. EEVC (not published).

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Working Group 6:

9. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 6 ON STRUCTURES FOR IMPROVED SIDE IMPACT PROTECTION IN EUROPE (1982). Structures Improved Side Impact Protection in Europe. Proceedings of the Ninth ESV Conference, Kyoto, November 1982.

Working Group 7:

10. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 7 ON PEDESTRIAN INJURY ACCIDENTS (1982). Pedestrian Injury Accidents. Proceedings of the Ninth ESV Conference, Kyoto, November 1982.

Working Group 8:

11. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 8 ON CYCLE AND LIGHT-POWERED TWO-WHEELER ACCIDENTS (1985). Cycle and light powered two-wheeler accidents. Proceedings of the Ninth IRCOBI Conference, Delft, September 1984, and Proceedings of the Tenth ESV Conference, Oxford, July 1985.

Working Group 9:

12. EUROPEAN EXPERIMENTAL VEHICLES COMMITTEE: WORKING GROUP 9 ON SIDE IMPACT TEST PROCEDURES (1988). Evaluation of the European Side Impact Dummy in rigid wall and padded wall sled tests. Proceedings of the IRCOBI/EEVC Workshop on the Evaluation of Side Impact Dummies, Bergisch-Gladbach, September 1988. (Janssen E G).

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Working Group 10:

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Working Group 11:

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Working Group 14:

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AD HOC GROUPS:

Side Impact

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APPENDIX 4

ACRONYMS USED IN THIS REPORT

AIS	Abbreviated Injury Scale (scale from 1 to 6 for categorising severity of injuries)
APR	Association Peugeot-Renault
BASt	Bundesanstalt fur Strassenwesen (Federal Institute for Transport, Germany)
EC	European Commission
ERGA	European Regulation - Global Approach (an advisory committee to the European Commission)
EU	European Union
EUROSID	European Side Impact Dummy
ESV	Enhanced Safety Vehicles (formerly Experimental Safety Vehicles)
FUPS	Front Underrun Protection System
INRETS	Institut National de Recherche sur les Transports et leur Securite (National Institute for Transport and Safety Research, France)
INTA	Instituto Nacional de Tecnica Aerospacial (National Technical Institute for Aerospace, Spain)
IRCOBI	International Research Committee on Biomechanics of Injury
ISO	International Standards Organisation
MADYMO	Mathematical Dynamic Models (a modelling package developed by TNO)
NHTSA	National Highways and Traffic Safety Administration (USA)
ODB	Offset Deformable Barrier (for the new frontal impact test)
TNO	Teogepast Natuurwetenschappelijk Onderzoek (Applied Scientific Research, Netherlands)
TRL	Transport Research Laboratory (UK)
UN-ECE	United Nations - Economic Commission for Europe (responsible, via Working Party 29, for developing vehicle regulations for acceptance by the European Commission, and more widely)
VTI	Vag-och Transportforkningsinstitut (Road and Traffic Research Institute, Sweden)
WP29	See UN-ECE