COMMISSION OF THE EUROPEAN COMMUNITIES

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Proposal for a
EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE

relating to the side-impact resistance of motor vehicles
and amending Directive 70/156/EEC

(presented by the Commission)

EXPLANATORY MEMORANDUM

1. SUMMARY

This proposal is aimed at reducing the number of people killed or seriously injured in road accidents by the introduction of new standards for the lateral impact resistance of passenger cars.

Applicable to new vehicle types approved after a certain date, the proposal sets out a new test procedure which when fully implemented will more realistically represent typical side-impact accidents.

The proposal incorporates the technical prescriptions developed by the United Nations Economic Commission for Europe, on the basis of experimental research work carried out by the European Experimental Vehicles Committee.

2. BACKGROUND

For some years the annual average number of people killed in road accidents in the European Community has been in the order of 50 000, with more than 1.5 million casualties and in excess of 0.5 million hospital admissions, at an estimated cost of around 70 billion ecus. And, whilst human factors are thought to be a major contributor to such accidents, the design of the vehicle can play a significant part in reducing the likelihood of an accident occurring (primary safety) and, in particular, minimising the extent of injuries to occupants and road users if an accident occurs (secondary safety).

Research has shown that injuries sustained as a result of vehicle side-impact accidents represents the second most significant cause of death and serious injury after frontal impact accidents, and that changes in the design of passenger car side structures offers considerable scope for casualty reduction. (The Commission is in parallel preparing an equivalent proposal relating to frontal impact).

This Memorandum therefore sets out the rationale behind the Commission's proposal for a new Council and Parliament directive relating to the side-impact resistance of motor vehicles.

3. EXISTING LEGISLATIVE SITUATION

3.1 EC Legislation

The list of directives within the framework for the type approval of motor vehicles includes a number of safety measures which are aimed at the reduction of casualties but, at present, the only one which specifically relates to the structural crashworthiness of the vehicle concerns the behaviour of the vehicle in a frontal rather than lateral impact.

3.2 American Federal Test FMVSS214

Passenger cars conforming to US regulations are required to comply with a side-impact test in which the static subject vehicle is struck by an object which, in terms of mass and approximate frontal form, represents another vehicle. Recognizing that in many side-impact accidents both vehicles are in motion, the test calls for the trajectory of the impactor to form an oblique angle with the principal axis of the struck vehicle. The ground clearance of the barrier is 279 mm. The test includes the use of instrumented dummies and bio-mechanical pass/fail criteria.

This has led to vehicle side structures being reinforced and stiffened in order to comply with the test.

4. RELEVANT RESEARCH WORK

The development of appropriate side-impact legislation has been the subject of considerable research activity for many years: in particular, the ERGA *ad-hoc* group (Evolution of Regulations-Global Approach- Passive Safety) was established by the Commission in 1985 with a remit to examine areas for legislative progress to improve the passive safety of vehicles. The group made a number of proposals regarding a possible side-impact test which were subsequently developed by the UN ECE in Geneva.

Also, the European Experimental Vehicle Committee (EEVC) has, for some years, carried out research into a number of areas affecting vehicle safety[1]. In particular, work has been focussed on the development of a mobile, deformable barrier side-impact test which more realistically reproduces the impact damage found in real car-to-car accidents.

Based on extensive accident research and a series of full-scale tests, the Committee proposed a test procedure which would provide a suitable level of protection for car occupants in side-impact accidents.

Unlike the US Federal test, the proposed European standard involves a perpendicular trajectory of the mobile barrier, a different speed and the use of a European test dummy in preference to the American equivalent. In these and other important respects the European standard has diverged from the American procedure, making harmonisation of test requirements less likely in this particular area. This reflects fundamental differences in the average size and weight of vehicles in the two areas.

5. DEVELOPMENT OF LEGISLATION BY UN ECE

The work of EEVC in this area of vehicle safety has been brought into the legislative arena via the United Nations Economic Commission for Europe (Working Group 29) and the Group of Experts on Passive Safety (GRSP) in particular.

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(1) EEVC brings together the national research laboratories of Europe and forms expert groups to reach a scientific and impartial consensus on what can be achieved, how to do it and what types of test procedures are needed. It involves experts from industry to ensure that its recommendations are fully practical in relation to manufacturing.

Unlike the development of the Regulation for frontal impact, which was largely based on the equivalent Federal standard, the lateral impact test requirements and ensuing regulation took considerable time and effort to prepare since there was no direct precedent. Towards the conclusion of the work certain critical elements of the proposal, which had not previously been questioned in the relevant working groups, became the focus of considerable discussion:

(a) Ground clearance of the mobile barrier

On the basis of examination of vehicle front end structures and damage caused to cars in real accident situations, the height of the lower edge of the mobile barrier was set initially at 300 mm, in line with the recommendation of the ERGA group in 1989.

A barrier with this amount of ground clearance would, when impacting the test vehicle, tend to over-ride the sill (the bottom section of the door frame, normally forming part of the vehicle platform, and inherently stiff) and require the majority of the energy to be absorbed by the door structure.

While this figure initially selected for the ground clearance did have a basis in research, industry with the support of a number of Member States argued that a the barrier height should be nearer 200 mm. This figure was derived from an examination of the frontal structures of vehicles in current production and the contention that, during real car-to-car side-impact accidents, the impacting vehicle is normally being braked, causing the front to dip and therefore result in a lower impacting point.

A barrier height in the order of 200 mm would mean that the sill of the impacted vehicle would be engaged and absorb a considerable proportion of the energy, thus reducing the effect upon the door structure.

(b) Viscous criteria for the test dummy

This is a measure of the force to which the thorax/abdomen of the dummy is subjected during the test, above which life-threatening injury to internal organs is likely to occur in real accidents.

As with the barrier height, there was a conflict between industry and others as to the stringency of this requirement.

(c) Position of front seat for test purposes

The text of the emerging Regulation allowed the Test Authority to select a different seat position for the approval test if, in their view, it represented a worse case than the nominal mid-position.

There was a concern that in testing in only one position, manufacturers might be tempted to provide particular protection for that single position and ignore potentially dangerous door hardware which, with the seat in a different position, might result in a test failure.

For manufacturers, the need to demonstrate compliance in all seating positions, and be prepared for the Test Authority to select any one of those positions, represented an unacceptable scenario where significant amounts of additional and costly development testing would be required to ensure a satisfactory performance whatever the chosen position.

EC Coordinated Position for WP29

At the Council ("113") Committee meeting to agree a coordinated position between the Member States for the October 1993 meeting of WP29, Member States were unable to agree a common position on the above issues. Since there was no possibility of agreement of the proposed Regulation in Geneva discussion was therefore postponed.

At the subsequent Council Coordination meeting, in preparation for the March 1994 WP29, Member States were faced with the need to adopt a compromise position if the stalemate, which was preventing the Regulation from being adopted, was to be avoided. Since an agreement had to be reached, Member States adopted the following compromise position on the three criteria:

(a)	Barrier Height	: 260 mm;
(b)	Viscous Criteria	: defer adoption of set value for two years.
(c)	Seat Position	: agree compromise text, meeting industry half-way.

It was accepted, on the issue of the barrier height, that although there were no experimental research results to validate a ground clearance of 260 mm (because much of the work had been based on the ERGA-recommended height of 300 mm), it would nevertheless constitute a step forward by introducing for the first time crash tests for side-impact and would entail design changes to the side structures of vehicles.

The resulting draft Regulation (TRANS/SC1/WP29/396) was adopted by WP29 in March 1994, on the basis of the coordinated position adopted by the EC, and will come into force once it has been approved by the United Nations organisation in New York.

6. LEGISLATIVE APPROACH PROPOSED BY THE COMMISSION

Aware of the considerable divergence in view over the key parameters of the test standard to be required in the proposed legislation, in the area of barrier height in particular, the Commission considered a number of criteria in reaching a conclusion:

- the need to maintain parity with UN ECE on technical prescriptions, particularly in view of the anticipated accession of the Community to the 1958 Agreement;

- the urgent need to introduce a Directive and improve safety standards;

- its statutory obligation under Article 100(a) of the Treaty to propose measures consistent with a high level of safety.

It was also of significance that Member States had themselves reached a coordinated position for the purposes of WP29 in Geneva; while this represents a different administrative and legal situation, it nonetheless has to be given due recognition.

The Commission has therefore come to the conclusion that the best approach is to propose technical standards that match those recently agreed by WP29 for the corresponding ECE Regulation but with a particular commitment to review the essential technical requirements, including a specific increase in the barrier height, after two years.

The rationale for this approach, in terms of the three criteria listed above, is as follows:

A. Parity with UN ECE

Given the on-going discussions with respect to the 1958 Agreement, the Commission considers that to establish divergent technical standards at this juncture would be inappropriate and might prejudice the outcome of the negotiations aimed at bringing the ECE and the EC closer together.

B. The Urgent Need to Introduce a Directive

Now that an agreement has been reached in Geneva, the Commission believes that every effort should be made to introduce a corresponding Directive without delay. Changing the technical requirements at this stage would result in further discussions and could well jeopardise the progress of the Directive through Council and Parliament.

By proceeding in effectively two steps a Directive can be quickly adopted, thus establishing competence in this area, allowing the requirements to be reviewed in the light of experience and further research, and to be updated by the procedure for Adaptation to Technical Progress.

C. Obligation to Propose a High Level of Safety

The technical requirements of the draft Directive represent a significant advance in vehicle safety legislation, especially since no side-impact crashworthiness standards exist at present.

Rather than adopt the 300 mm barrier height immediately, which is the subject of intense controversy as to whether it does actually represent typical car-to-car side-impact accidents, the Commission supports the introduction of the 260 mm barrier height, as agreed by the ECE, as an interim measure and proposes to introduce 300 mm on an optional basis from 1 January 1998, becoming mandatory from 1 October 2001.

In order to recognize the significant consequences that such a standard will have for vehicle manufacturers, the Commission has proposed that the date for the applicability of the 300 mm barrier height to all new vehicles (as distinct from new vehicle types) should be subject to an assessment of the operation of the Directive to date and the industrial feasibility of such a measure. The date of 1 October 2002 therefore has been made subject to the submission of a report from the Commission to the Council and European Parliament.

7. EFFECT UPON INDUSTRY

It is acknowledged that the technical requirements of the proposed Directive are such that many car types in current production would have difficulty in complying, especially with regard to the barrier. However, the draft Directive will only apply to new vehicle types submitted for approval after 1 October 1995 and will not apply to existing vehicle types until the year 2000.

Whilst the effect will be to necessitate significant changes to the side structure of vehicles, these will be incorporated at the design stage of new vehicles and therefore minimise any additional cost. Indications are that, unlike the US legislation, vehicles will not have to be any heavier in order to comply.

8. CONCLUSION

Recent research has indicated that an annual reduction of approximately 25 000 deaths and serious injuries could be achieved by improved side-impact protection.

In seeking to introduce appropriate measures to improve the side-impact standards for new vehicle types, and thus reduce occupant injuries, the Commission has proposed a draft Directive which when fully implemented will significantly affect the design of future passenger cars in this respect.

This standard is well within the capacity of vehicle manufacturers when considering new designs, and should not result in additional manufacturing costs; sufficient lead time will be provided to allow them to incorporate the requirements.

Proposal for a

EUROPEAN PARLIAMENT AND COUNCIL DIRECTIVE

relating to the side-impact resistance of motor vehicles and amending Directive 70/156/EEC

THE EUROPEAN PARLIAMENT AND THE COUNCIL OF THE EUROPEAN UNION,

Having regard to the Treaty establishing the European Community and in particular to Article 100a,

Having regard to the proposal from the Commission[1],

Having regard to the opinion of the Economic and Social Committee[2],

Having regard to Council Directive 70/156/EEC of 6 February 1970 on the approximation of the laws of the Member States relating to the type-approval of motor vehicles and their trailers[3], as last amended by Commission Directive 93/81/EEC[4], and in particular Article 13(4) thereof;

Whereas the internal market comprises an area without internal frontier in which the free movement of goods, persons, services and capital must be ensured; whereas the total harmonization of technical requirements for motor vehicles is necessary in order to fully achieve that objective;

Whereas in order to reduce the number of European road accident casualties, it is necessary to introduce legislative measures so as to improve the vehicular crash worthiness of motor vehicles so far as practicable; whereas this Directive introduces side-impact test requirements, including biomechanical criteria, to ensure that a reasonable level of side-impact resistance is provided;

Whereas these requirements should be regarded as an interim measure and will need to be reviewed in the light of further research and experience gained during the first two years of approval tests carried out in accordance with this Directive; whereas provision should be made to ensure a higher level of safety in the future by the establishment of more stringent standards;

Whereas this Directive will be one of the separate directives which must be complied with in order to conform to the EEC type-approval procedure established by Directive 70/156/EEC; whereas, consequently, the provisions laid down in Directive 70/156/EEC relating to vehicle systems, components and separate technical units apply to this Directive;

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(1) OJ No

(2) OJ No

(3) OJ No L 42, 23.2.1970, p. 1.

(4) OJ No L 264, 23.10.1993, p. 49.

Whereas the procedure for determining the reference point for seating positions in motor vehicles is given in Annex III to Council Directive 77/649/EEC[5], as last amended by Commission Directive 90/630/EEC[6], and consequently it is not necessary to repeat it in this Directive; whereas, reference should be made to Council Directive 70/387/EEC[7], Directive 74/483/EEC[8], as last amended by Directive 87/354/EEC[9], and Directive 76/115/EEC[10], as last amended by Commission Directive 90/629/EEC[11], and to ISO Standard 6487: 1987;

Whereas the technical requirements of this Directive are based on United Nations Economic Commission for Europe document TRANS/SC1/WP29/396,

HAVE ADOPTED THIS DIRECTIVE:

Article 1

For the purposes of this Directive, "vehicle" shall have the meaning given to it in Article 2 of Directive 70/156/EEC.

Article 2

1. No Member State may, on grounds relating to side-impact resistance:

   - refuse, in respect of a type of vehicle, to grant EEC type-approval or national type-approval, or

   - prohibit the registration, sale or entry into service of a vehicle,

   if it complies with the requirements of this Directive.

2. With effect from 1 October 1995 Member States:

   - shall not grant EEC type-approval in accordance with Article 4 of Directive 70/156/EEC, and

   - may refuse to grant national type-approval,

   unless the vehicle type satisfies the requirements of this Directive.

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(5) OJ No L 267, 19.10.1977, p. 1.
(6) OJ No L 341, 6.12.1990, p. 20.
(7) OJ No L 176, 10.8.1970, p. 5.
(8) OJ No L 266, 2.10.1974, p. 4.
(9) OJ No L 192, 11.7.1987, p. 43.
(10) OJ No L 24, 30.1.1976, p. 6.
(11) OJ No L 341, 6.12.1990, p. 14.

3. Paragraph 2 shall not apply to vehicle types approved before 1 October 1995 pursuant to any two of the following directives: Directive 70/387/EEC (latches and hinges), Directive 74/483/EEC (exterior projections) and Directive 76/115/EEC (seat belt anchorages) and, where applicable, subsequent extensions to these approvals.

4. With effect from 1 October 2000 Member States shall consider certificates of conformity which accompany new vehicles in accordance with Directive 70/156/EEC to be no longer valid for the purposes of Article 7 (1) of that Directive, if the requirements of this Directive are not fulfilled.

Article 3

Annex IV to Directive 70/156/EEC is hereby amended as follows:

1. In Part I, the following item is added:

"54. Side-impact resistance 95/.../EEC L... X - - X - - - - - -"

2. In Part II, the following item is added:

"54. Side-impact resistance ..."

Article 4

1. In the framework of the adaptation of this Directive to technical progress, a second stage shall be adopted by the Commission. It shall be based on a review of the technical criteria and in particular the viscous criteria, front seat position and the ground clearance of the barrier. The review criteria will include inter alia accident statistics, accident research data, full scale car-to-car test results, experience gained from approval tests and cost-benefit considerations. Notwithstanding the above, the ground clearance of the barrier shall be increased to 300 mm, unless the review demonstrates that a different barrier height would provide an equivalent level of protection.

2. This second stage shall be applicable at the request of manufacturers on an optional basis from 1 January 1998 and shall be mandatory for new vehicle types approved from 1 October 2001.

3. This second stage will be applicable to all new vehicles from 1 October 2004, subject to a report from the Commission to the European Parliament and Council to be made no later than 1 October 2002 on the operation of the Directive and the industrial feasibility of the above date.

Article 5

1. Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive before 1 October 1995. They shall forthwith inform the Commission thereof.

When Member States adopt these provisions, these shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The procedure for making such reference shall be adopted by Member States.

2. Member States shall communicate to the Commission the texts of the main provisions of national law which they adopt in the field covered by this Directive.

Article 6

This Directive shall enter into force the twentieth day following that of its publication in the Official Journal of the European Communities.

Article 7

This Directive is addressed to the Member States.

Done at Brussels,

For the European Parliament
The President

For the Council
The President

LIST OF ANNEXES

[redacted]

ANNEX I

ADMINISTRATIVE PROVISIONS FOR TYPE-APPROVAL

1. APPLICATION FOR EEC TYPE APPROVAL

1.1 The application for EEC type-approval pursuant to Article 3 (4) of Directive 70/156/EEC of a vehicle type with regard to its side-impact protection shall be submitted by the manufacturer.

1.2 A model for the information document is given in Appendix 1.

1.3 A vehicle representative of the vehicle type to be approved shall be submitted to the technical service responsible for conducting the type-approval tests.

1.4 The manufacturer shall be entitled to present any data and results of tests carried out which make it possible to establish that compliance with the requirements can be achieved with a sufficient degree of confidence.

2. GRANTING OF EEC TYPE-APPROVAL

2.1 If the relevant requirements are satisfied, EEC type-approval pursuant to Article 4 (3) and, if applicable, 4 (4) of Directive 70/156/EEC shall be granted.

2.2 A model for the EEC type-approval certificate is given in Appendix 2.

2.3 An approval number in accordance with Annex VII to Directive 70/156/EEC shall be assigned to each type of vehicle approved. The same Member State shall not assign the same number to another type of vehicle.

2.4 In case of doubt, account shall be taken, when verifying the compliance of the vehicle with the requirements of this Directive, of any data or test results provided by the manufacturer which can be taken into consideration in validating the approval test carried out by the approval authority.

3. MODIFICATION OF THE TYPE AND AMENDMENTS TO APPROVALS

3.1 In the case of amendments to approvals granted pursuant to this Directive, the provisions of Article 5 of Directive 70/156/EEC shall apply.

3.2 Any modification of the vehicle affecting the general form of the structure of the vehicle or any variation in the reference mass greater than 8 % which in the judgement of the authority would have a marked influence on the results of the test shall require a repetition of the test as described in Appendix 1 of Annex II.

3.3 If the technical service, after consultation with the vehicle manufacturer, considers that modifications to a vehicle type are insufficient to warrant a complete retest then a partial test may be used. This would be the case if the reference mass is not more than 8 % different from the original vehicle or the number of front seats is unchanged. Variations of seat type or interior fittings need not automatically entail a full retest. An example of approach to this problem is given in Appendix 5 of Annex II.

4. CONFORMITY OF PRODUCTION

4.1 As a general rule, measures to ensure the conformity of production shall be taken in accordance with the provisions laid down in Article 10 of Directive 70/156/EEC.

ANNEX I

Appendix 1

Information document No .....

pursuant to Annex I of Council Directive 70/156/EEC*

relating to the EEC type-approval of a vehicle with respect to

side-impact resistance

The following information, if applicable, must be supplied in triplicate and include a list of contents. Any drawings must be supplied in appropriate scale and in sufficient detail on size A4 or on a folder of A4 format. Photographs, if any, must show sufficient detail.

If the systems, components or separate technical units have electronic controls, information concerning their performance must be supplied.

0	**GENERAL**
0.1	Make (trade name of manufacturer):
0.2	Type and general commercial description(s):
0.3	Means of identification of type, if marked on the vehicle[(b)]:
0.3.1	Location of that marking:
0.4	Category of vehicle[(c)]:
0.5	Name and address of manufacturer:
0.8	Address(es) of assembly plant(s):

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* The item numbers and footnotes used in this Information Document correspond to those set out in Annex I to Directive 70/156/EEC.

Items not relevant for the purposes of this Directive are omitted.

1. GENERAL CONSTRUCTION CHARACTERISTICS OF THE VEHICLE

1.1 Photographs and/or drawings of a representative vehicle:

1.6 Position and arrangement of the engine :

9. BODYWORK

9.1 Type of bodywork :

9.2 Materials used and methods of construction :

9.3 Occupant doors, latches and hinges

9.3.1 Door configuration and number of doors :

9.3.1.1 Dimensions, direction and maximum angle of opening :

9.3.2 Drawing of latches and hinges and of their position in the doors :

9.3.3 Technical description of latches and hinges :

9.10 Interior fittings

9.10.3 Seats

9.10.3.1 Number :

9.10.3.2 Position and arrangement :

9.10.3.3 Mass :

9.10.3.4 Characteristics: description and drawing of

9.10.3.4.1 the seats and their anchorages :

9.10.3.4.2 the adjustment system :

9.10.3.4.3 the displacement and locking systems :

9.10.3.4.4 the seat belt anchorages (if incorporated in the seat structure) :

Date, file

ANNEX 1

Appendix 2

MODEL

(maximum format : A4 (210 x 297 mm)

EEC TYPE-APPROVAL CERTIFICATE

STAMP OF ADMINISTRATION

Communication concerning the

- type-approval (1)
- extension of type-approval (1)
- refusal of type-approval (1)
- withdrawal of type-approval (1)

of a type of vehicle/component/separate technical unit (1) with regard to Directive ../.../EEC, as last amended by Directive ../.../EEC (1)

Type-approval Number .....

Reason for extension .....

SECTION I

0.1 Make (trade name of manufacturer):

0.2 Type and general commercial description(s):

0.3 Means of identification of type, if marked on the vehicle/component/separate technical unit (1)(2):

0.3.1 Location of that marking:

0.4 Category of vehicle (3):

0.5 Name and address of manufacturer:

0.7 In the case of components and separate technical units, location and method of affixing of the EEC type-approval mark:

0.8 Address(es) of assembly plant(s):

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(1) Delete where not applicable.

(2) If the means of identification of type contains characters not relevant to a description of the vehicle, component or separate technical unit types covered by this type-approval certificate, such characters shall be represented in the documentation by the symbol "?" (e.g. ABC??123???).

(3) As defined in Annex II A to Directive 70/156/EEC.

SECTION II

1 Additional information (where applicable) (see Addendum)

2 Technical service responsible for carrying out the tests:

3 Date of test report:

4 Number of test report:

5 Remarks (if any) (see Addendum)

6 Place:

7 Date:

8 Signature:

9 The index to the information package lodged with the approval authority, which may be obtained on request, is attached.

ADDENDUM

to EEC type-approval certificate no .....

concerning the type-approval of a vehicle with regard to

Directive / /EEC.

1 Additional information

1.1 Brief description of the vehicle type as regards its structure, dimensions, lines and constituent materials :

1.2 Description of the protective system installed in the vehicle :

1.3 Description of the interior arrangements or fittings that might affect the tests :

1.4 Location of engine : forward / rear / central (1)

1.5 Drive : front-wheel : rear-wheel (1)

1.6 Mass of vehicle submitted for testing -

Front axle :

Rear axle :

Total :

2 Type of barrier used in approval test:

5 Remarks : (eg. valid for left-hand drive and right-hand drive vehicles)

ANNEX II

TECHNICAL REQUIREMENTS

1. SCOPE

This Directive applies to the lateral impact behaviour of the structure of the passenger compartment of M_1 and N_1 categories of vehicles where the R - point of the lowest seat is not more than 700 mm from ground level when the vehicle is in the condition corresponding to the reference mass defined in Paragraph 2.10 of this Directive, with the exception of multi-stage build vehicles produced in quantities not exceeding those fixed for a small series.

2. DEFINITIONS

For the purposes of this Directive:

2.1 "Approval of a vehicle" means the approval of a vehicle type with regard to the behaviour of the structure of the passenger compartment in a lateral impact;

2.2 "Vehicle type" means a category of power-driven vehicles which do not differ in such essential respects as:

2.2.1 the length, width and ground clearance of the vehicle, in so far as they have a negative effect on the performance prescribed in this Directive;

2.2.2 the structure, dimensions, lines and materials of the side walls of the passenger compartment in so far as they have a negative effect on the performance prescribed in this Directive;

2.2.3 the lines and inside dimensions of the passenger compartment and the type of protective systems, in so far as they have a negative effect on the performance prescribed in this Directive;

2.2.4 the siting of the engine (front, rear or centre);

2.2.5 the unladen mass, in so far as there is a negative effect on the performance prescribed in this Directive;

2.2.6 the optional arrangements or interior fittings in so far as they have a negative effect on the performance prescribed in this Directive;

2.2.7 the type of front seat(s) and position of the R - point in so far as they have a negative effect on the performance prescribed in this Directive;

2.3 "Passenger compartment" means the space for occupant accommodation, bounded by the roof, floor, side walls, doors, outside glazing and front bulkhead and the plane of the rear compartment bulkhead or the plane of the rear-seat back support;

2.4 "R point" or "seating reference point" means the reference point specified by the vehicle manufacturer which:

2.4.1 has coordinates determined in relation to the vehicle structure;

2.4.2 corresponds to the theoretical position of the point of torso/thighs rotation (H point) for the lowest and most rearward normal driving position or position of use given by the vehicle manufacturer for each seating position specified;

2.5 "H point" is as established by Directive 77/649/EEC;

2.6 "Capacity of the fuel tank" means the fuel tank capacity as specified by the manufacturer of the vehicle;

2.7 "Transverse plane" means a vertical plane perpendicular to the median longitudinal vertical plane of the vehicle;

2.8 "Protective system" means devices intended to restrain and/or protect the occupants;

2.9 "Type of protective system" means a category of protective devices which do not differ in such essential respects as their:

technology,
geometry or
constituent materials;

2.10 "Reference mass" means the unladen mass of the vehicle increased by a mass of 100 kg (that is the mass of the side impact dummy and its instrumentation);

2.11 "Unladen mass" means the mass of the vehicle in running order without driver, passengers or load, but with the fuel tank filled to 90% of its capacity and the usual set of tools and spare wheel on board, where applicable;

2.12 "Mobile deformable barrier" means the apparatus with which the test vehicle is impacted. It consists of a trolley and an impactor;

2.13 "Impactor" means a crushable section mounted on the front of mobile deformable barrier;

2.14 "Trolley" means a wheeled frame free to travel along its longitudinal axis at the point of impact. Its front part supports the impactor.

2.15 "Multi-stage build" means the procedure whereby two or more manufacturers separately and sequentially participate in the construction of a vehicle.

3. SPECIFICATIONS AND TESTS

3.1 The vehicle shall undergo a test in accordance with Appendix 1 to this Annex.

3.1.1 The test will be carried out on the driver's side unless asymmetric side structures, if any, are so different as to affect the performance in a side impact. In that case either of the alternatives in Paragraph 3.1.1.1 or 3.1.1.2 may be used by agreement between the manufacturer and test authority.

3.1.1.1 The manufacturer will provide the authority responsible for approval with information regarding the compatibility of performances in comparison with the driver's side when the test is being carried out on that side.

3.1.1.2 The approval authority, if concerned as to the construction of the vehicle, will decide to have the test performed on the side opposite the driver, this being considered the least favourable.

3.1.2 The Test Authority, after consultation with the manufacturer, may require the test to be carried out with the seat in a position other than the one indicated in Paragraph 5.5.1 of Appendix 1.(1)

3.1.3 The result of this test shall be considered satisfactory if the conditions set out in Paragraphs 3.2. and 3.3. below are satisfied.

3.2. Performance criteria

3.2.1 The performance criteria, as determined for the impact test in accordance with the Addendum to Appendix 1 to this Annex shall meet the following conditions:

3.2.1.1 the head performance criterion (HPC) shall be less than or equal to 1000; when there is no head contact, then the HPC shall not be measured or calculated but recorded as "No Head Contact."

3.2.1.2 the thorax performance criteria shall be:

(a) Rib Deflection Criterion (RDC) less than or equal to 42 mm;
(b) Soft Tissue Criterion (VC) less or equal to 1.0 m/s.

For a transitional period of two years after the date shown in Article 2 § 2 of this Directive the VC value is not a pass/fail criterion for the approval testing, but this value has to be recorded in the test report and to be collected by the approval authorities. After this transitional period, the VC value of 1.0 m/s shall apply as a pass/fail criterion unless or until an alternative value is approved by the Committee for Adaptation to Technical Progress.

3.2.1.3 the pelvis performance criterion shall be:

Pubic Symphysis Peak Force (PSPF) less than or equal to 6 kN.

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(1) Until 30 September 1998, for the purposes of the test requirements, the range of normal longitudinal adjustments shall be limited such that the H-point lies within the length of the door aperture.

3.2.1.4 the abdomen performance criterion shall be:

Abdominal Peak Force (APF) less than or equal to 2.5 kN internal force (equivalent to external force of 4.5 kN).

3.3 Particular requirements

3.3.1 No door shall open during the test.

3.3.2 After the impact, it shall be possible without the use of tools to:

3.3.2.1 open a sufficient number of doors provided for normal entry and exit of passengers, and if necessary tilt the seat backs or seats, to allow evacuation of all occupants;

3.3.2.2 release the dummy from the protective system;

3.3.2.3 remove the dummy from the vehicle;

3.3.3 no interior device or component shall become detached in such a way as noticeably to increase the risk of injury from sharp projections or jagged edges;

3.3.4 ruptures, resulting from permanent deformation are acceptable, provided these do not increase the risk of injury;

3.3.5 if there is continuous leakage of liquid from the fuel-feed installation after the collision, the rate of leakage shall not exceed 5×10^{-4} kg/s; if the liquid from the fuel-feed system mixes with liquids from the other systems and the various liquids cannot easily be separated and identified, all the liquids collected shall be taken into account in evaluating the continuous leakage.

Appendix 1

IMPACT TEST PROCEDURE

1. INSTALLATIONS

1.1 Testing ground

The test area shall be large enough to accommodate the mobile deformable barrier propulsion system and to permit after-impact displacement of the vehicle impacted and installation of the test equipment. The part in which vehicle impact and displacement occur shall be horizontal, flat and uncontaminated, and representative of a normal, dry, uncontaminated road surface.

2. TEST CONDITIONS

2.1 The vehicle to be tested shall be stationary.

2.2 The mobile deformable barrier shall have the characteristics set out in Appendix 2 to Annex II. Requirements for the examination are given in the Addendum to Appendix 2. The mobile deformable barrier shall be equipped with a suitable device to prevent a second impact on the struck vehicle.

2.3 The trajectory of the mobile deformable barrier longitudinal median vertical plane shall be perpendicular to the longitudinal median vertical plane of the impacted vehicle.

2.4 The longitudinal vertical median plane of the mobile deformable barrier shall be coincident within ± 25 mm with a transverse vertical plane passing through the R point of the front seat adjacent to the struck side of the tested vehicle. The horizontal median plane limited by the external lateral vertical planes of the front face shall be at the moment of impact within two planes determined before the test and situated 25 mm above and below the previously defined plane.

2.5 Instrumentation shall comply with ISO 6487:1987 unless otherwise specified in this Directive.

2.6 The stabilised temperature of the test dummy at the time of the side impact test shall be 22 ± 4°C.

3. TEST SPEED

Mobile deformable barrier speed at the moment of impact shall be 50 ± 1 km/h. This speed shall be stabilised at least 0.5 m before impact. Accuracy of measurement: 1 %. However, if the test was performed at a higher impact speed and the vehicle met the requirements, the test shall be considered satisfactory.

4. STATE OF THE VEHICLE

4.1 General specification

The test vehicle shall be representative of the series production, shall include all the equipment normally fitted and shall be in normal running order. Some components may be omitted or replaced by equivalent masses where this omission or substitution clearly has no effect on the results of the test.

4.2 Vehicle equipment specification

The test vehicle shall have all the optional arrangements or fittings likely to influence the results of the test.

4.3 Mass of the vehicle

4.3.1 The vehicle to be tested shall have the reference mass as defined in Paragraph 2.10 of Annex II to this Directive. The mass of the vehicle shall be adjusted to ± 1 % of the reference mass.

4.3.2 The fuel tank shall be filled with water to a mass equal to 90 % of the mass of a full load of fuel as specified by the manufacturer.

4.3.3 All the other systems (brake, cooling, etc.) may be empty; in this case, the mass of the liquids shall be offset.

4.3.4 If the mass of the measuring apparatus on board of the vehicle exceeds the 25 kg allowed, it may be offset by reductions which have no noticeable effect on the results of the test.

4.3.5 The mass of the measuring apparatus shall not change each axle reference load by more than 5 %, each variation not exceeding 20 kg.

5. PREPARATION OF THE VEHICLE

5.1 The side windows at least on the struck side shall be closed.

5.2 The doors shall be closed, but not locked.

5.3 The transmission shall be placed in neutral and the parking brake disengaged.

5.4 The comfort adjustments of the seats, if any, shall be adjusted to the position specified by the vehicle manufacturer.

5.5 The seat containing the dummy, and its elements, if adjustable, shall be adjusted as follows:

5.5.1 The longitudinal adjustment device shall be placed with the locking device engaged in the position that is nearest to midway between the foremost and rearmost positions; if this position is between two notches, the rearmost notch shall be used.

5.5.2 The head restraint shall be adjusted such that its top surface is level with the centre of gravity of the dummy's head; if this is not possible, the head restraint shall be in the uppermost position.

5.5.3 Unless otherwise specified by the manufacturer, the seat-back shall be set such that the torso reference line of the three-dimensional H point machine is set at an angle of 25 ± 1° towards the rear.

5.5.4 All other seat adjustments shall be at the mid-point of available travel; however, height adjustment shall be at the position corresponding to the fixed seat, if the vehicle type is available with adjustable and fixed seats. If locking positions are not available at the respective mid-points of travel, the positions immediately rearward, down, or outboard of the mid-points shall be used. For rotational adjustments (tilt), rearward will be the adjustment direction which moves the head of the dummy rearwards. If the dummy protrudes outside the normal passenger volume, e.g. head into roof lining, then 10 mm clearance will be provided using: secondary adjustments, seat back angle, or fore-aft adjustment in that order.

5.6 Unless otherwise specified by the manufacturer, the other front seats shall, if possible, be adjusted to the same position as the seat containing the dummy.

5.7 If the steering wheel is adjustable, all adjustments are positioned to their mid-travel locations.

5.8 Tyres shall be inflated to the pressure specified by the vehicle manufacturer.

5.9 The test vehicle shall be set horizontal about its roll axis and maintained by supports in that position until the side impact dummy is in place and after all preparatory work is complete.

5.10 The vehicle shall be at its normal attitude corresponding to the conditions set out in Paragraph 4.3. above. Vehicles with suspension enabling their ground clearance to be adjusted shall be tested under the normal conditions of use at 50 km/h as defined by the vehicle manufacturer. This shall be assured by means of additional supports, if necessary, but such supports shall have no influence on the crash behaviour of the test vehicle during the impact.

6. SIDE IMPACT DUMMY AND ITS INSTALLATION

6.1 The side impact dummy shall comply with the specifications given in Appendix 3 and be installed in the front seat on the impact side according to the procedure given in Appendix 4 to this Annex.

6.2 The safety-belts or other restraint systems, which are specified for the vehicle, shall be used. Belts should be of an approved type, conforming to Directive 77/541/EEC and mounted on anchorages conforming to Directive 76/115/EEC.

6.3 The safety-belt or restraint system shall be adjusted to fit the dummy in accordance with the manufacturer's instructions; if there are no manufacturer's instructions, the height adjustment if provided shall be set at middle position; if this position is not available, the position immediately below shall be used.

7. MEASUREMENTS TO BE MADE ON THE SIDE IMPACT DUMMY

7.1 The readings of the following measuring devices are to be recorded.

7.1.1 Measurements in the head of the dummy

The resultant triaxial acceleration referring to the head centre of gravity. The head channel instrumentation shall comply with ISO 6487:1987 with:

CFC: 1000 Hz, and
CAC: 150 g

7.1.2 Measurements in the thorax of the dummy

The three thorax rib deflection channels shall comply with ISO 6487:1987

CFC: 1000 Hz
CAC: 60 mm

7.1.3 Measurements in the pelvis of the dummy

The pelvis force channel shall comply with ISO 6487:1987

CFC: 1000 Hz
CAC: 15 kN

7.1.4 Measurements in the abdomen of the dummy

The abdomen force channels shall comply with ISO 6487:1987

CFC: 1000 Hz
CAC: 5 kN

Appendix 1 - Addendum 1

DETERMINATION OF PERFORMANCE DATA

The required results of the tests are specified in Paragraph 3.2. of Annex II.

1. HEAD PERFORMANCE CRITERION (HPC)

When head contact takes place, this performance criterion is calculated for the total duration between the initial contact and the last instant of the final contact.

HPC is the maximum value of the expression:

$$(t_2 - t_1)\left[\frac{1}{(t_2 - t_1)}\int_{t1}^{t2} a.dt\right]^{2.5}$$

where a is the resultant acceleration at the centre of gravity of the head (m/s^2) divided by 9.81 recorded versus time and filtered at channel frequency class 1000 Hz; t_1 and t_2 are any two times between the initial contact and the last instant of the final contact.

2. THORAX PERFORMANCE CRITERIA

2.1. Chest deflection: the peak chest deflection is the maximum value of deflection on any rib as determined by the thorax displacement transducers, filtered at channel frequency class 180 Hz.

2.2. Viscous criterion: the peak viscous response is the maximum value of VC on any rib which is calculated from the instantaneous product of the relative thorax compression related to the half thorax and the velocity of compression derived by differentiation of the compression, filtered at channel frequency class 180 Hz. For the purposes of this calculation the standard width of the half thorax rib cage is 140 mm

$$VC = MAX\left[\left(\frac{D}{0.140}\right)\bullet\left(\frac{dD}{dt}\right)\right]$$

where D (m) = rib deflection

The calculation algorithm to be used is set out in Addendum 2 of this Appendix

3. ABDOMEN PROTECTION CRITERION

The peak abdominal force is the maximum value of the sum of the three forces measured by transducers mounted 39 mm below the surface on the crash side, CFC 600 Hz.

4. PELVIS PERFORMANCE CRITERION

The pubic symphisis peak force (PSPF) is the maximum force measured by a load cell at the pubic symphysis of the pelvis, filtered at channel frequency class 600 Hz.

Appendix 1 -Addendum 2

(Reserved for introduction of a calculation algorithm of the Viscous Criterion)

Appendix 2

MOBILE DEFORMABLE BARRIER CHARACTERISTICS

1. CHARACTERISTICS OF THE BARRIER

1.1 The total mass shall be 950 ± 20 kg.

1.2 The front and rear track width of the trolley shall be 1500 ± 10 mm.

1.3 The wheel base of the trolley shall be 3000 ± 10 mm.

1.4 The centre of gravity shall be situated in the longitudinal median vertical plane within 10 mm, 1,000 ± 30 mm behind the front axle and 500 ± 30 mm above the ground.

1.5 The distance between the front face of the impactor and the centre of gravity of the barrier shall be 2000 ± 30 mm.

2. CHARACTERISTICS OF THE IMPACTOR

2.1. Geometrical characteristics

2.1.1 The impactor consists of six independent joined parts whose forms, sizes and positioning are shown in figure 1.

2.1.2 The deformable impact zone shall be 1500 ± 10 mm wide and 500 ± 5 mm high.

2.1.3 The ground clearance of the collision zone shall be 260 mm ± 5 mm measured in static condition before impact, subject to the provisions of Article 4 of this Directive.

2.1.4 There shall be six deformable elements, divided into two rows of three elements. All the elements shall have the same width (500 ± 5 mm) and the same height (250 ± 3 mm); the elements of the upper row shall be 440 ± 5 mm deep and those of the lower row 500 ± 5 mm deep.

2.2 Material characteristics

The material of the impactor must be an aluminium honeycomb. Other materials can be used if equal results as described in Paragraph 2.3. have been proved to the satisfaction of the Technical Service. In any case the type of impactor must be indicated in the test report.

2.3. Deformation characteristics

2.3.1 Deviation from the limits of the force-deflection corridors characterising the rigidity of the impactor - as defined in this Appendix, Figure 2 - may be allowed provided that:

2.3.1.1 the deviation occurs after the beginning of the impact and before the deformation of the impactor is equal to 150 mm;

2.3.1.2 the deviation does not exceed 50 % of the nearest instantaneous prescribed limit of the corridor;

2.3.1.3 each displacement corresponding to each deviation does not exceed 35 mm of the deflection, and the sum of these displacements does not exceed 70 mm (see Figure 2) and

2.3.1.4 the sum of the energy derived from deviating outside the corridor does not exceed 5 % of the gross energy for that block.

2.3.2 Parts 1 and 3 are identical. Their rigidity is such that their force-deflection curves fall within the hatched area of Figure 2, Graph 2a.

2.3.3 Parts 5 and 6 are identical. Their rigidity is such that their force-deflection curves fall within the hatched area of Figure 2, Graph 2d.

2.3.4 The rigidity of Part 2 is such that its force-deflection curve falls within the hatched area of Figure 2, Graph 2b.

2.3.5 The rigidity of Part 4 is such that its force-deflection curve falls within the hatched area of Figure 2, Graph 2c.

2.3.6 The force-deflection of the impactor as a whole shall fall within the hatched area of Figure 2, Graph 2e.

2.3.7 The force-deflection curves shall be verified by a test detailed in the addendum to this appendix, consisting of an impact of the assembly against a dynamo metric barrier at 35 ± 2 km/h.

2.3.8 The dissipated energy(1) against parts 1 and 3 during the test shall be equal to 10 ± 2 kJ for each of these parts.

2.3.9 The dissipated energy against parts 5 and 6 shall be equal to 3.5 ± 1 kJ for each of these parts.

2.3.10 The dissipated energy against part 4 shall be equal to 4 ± 1 kJ.

2.3.11 The dissipated energy against part 2 shall be equal to 14 ± 2 kJ.

2.3.12 The total dissipated energy during the impact shall be equal to 45 ± 5 kJ.

---

(1) The amounts of energy indicated are the amounts of energy dissipated by the system when the extent to which the impactor is crushed is greatest.

2.3.13 Impactor deformation measured after the test at level B (Figure 1) shall be equal to 330 ± 20 mm.

Figure 1

Design of the mobile deformable barrier impactor

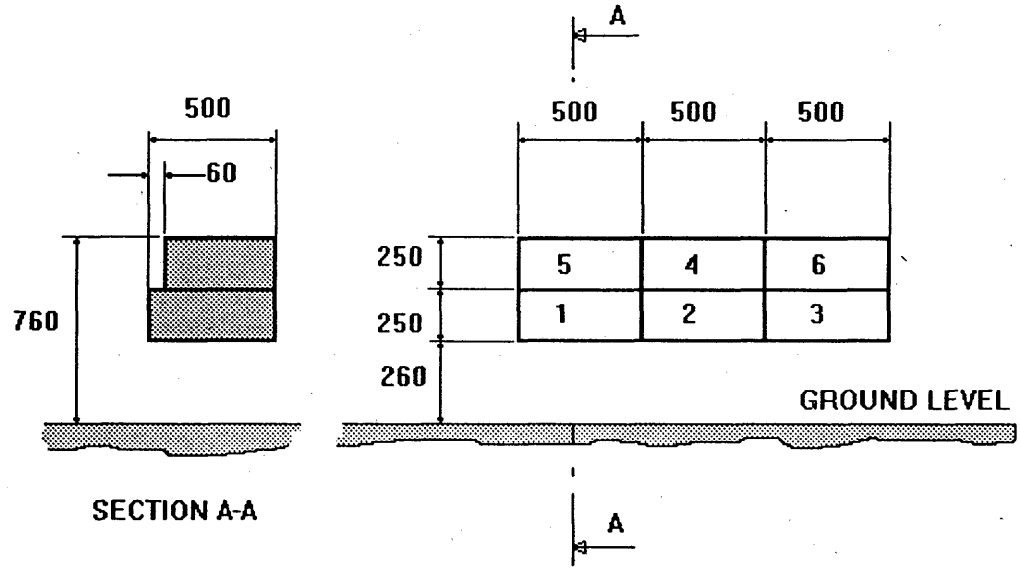
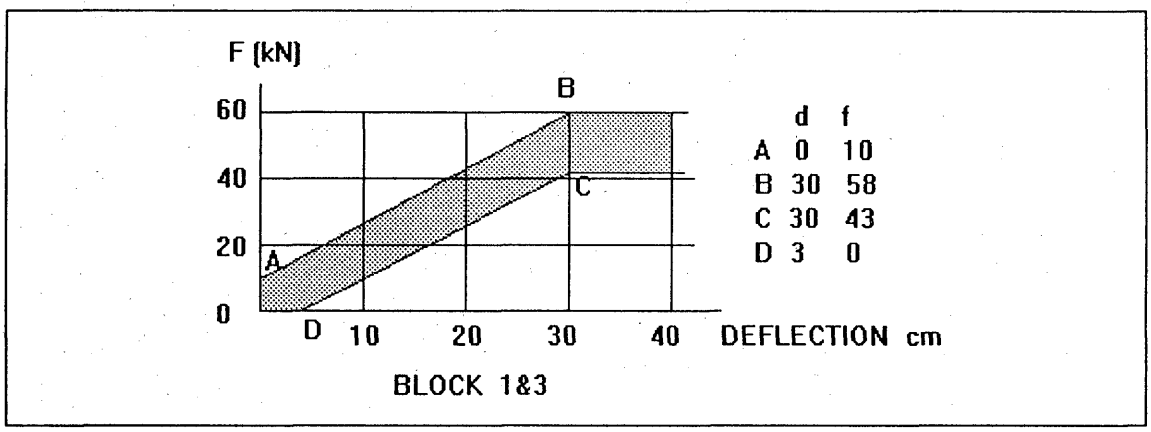
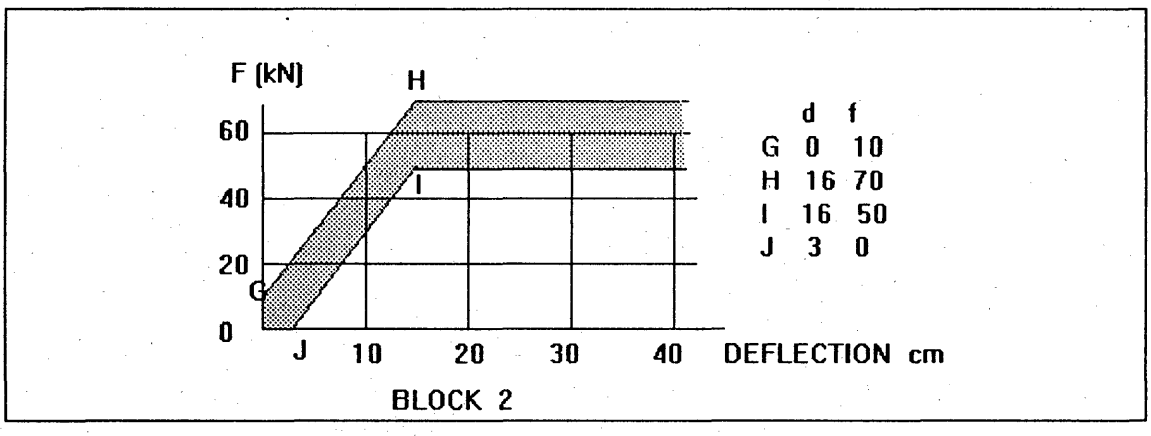


Figure 2

Force-deflection curves





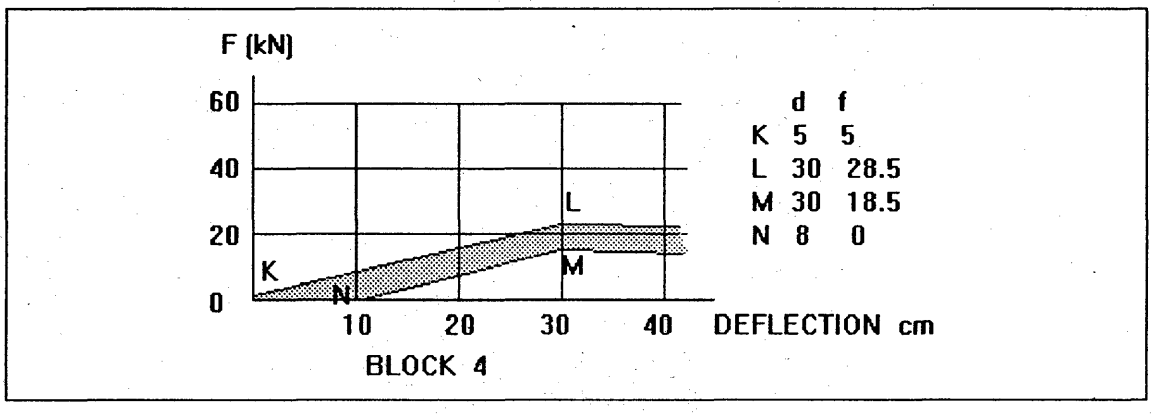
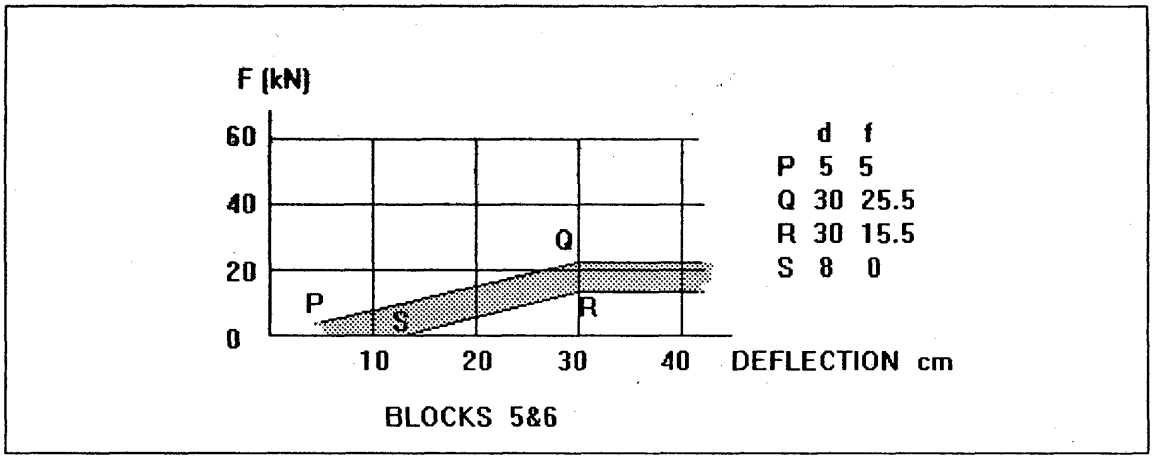
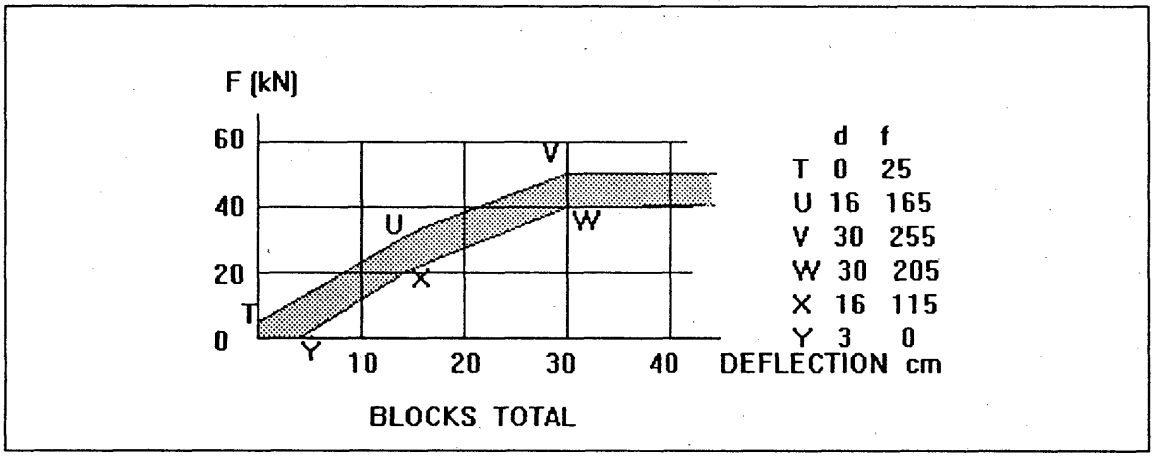


Figure 1 (continued)





Note: During the verification test, the loads measured on parts 1 and 3 and on parts 5 and 6 respectively shall not differ by more than 10 per cent for a given deflection.

Appendix 2 - Addendum

EXAMINATION OF THE MOBILE DEFORMABLE BARRIER

1. SCOPE

This addendum contains a prescription for the examination of the mobile deformable barrier. The test authority is responsible for the mobile deformable barrier meeting the specifications using a test against a dynamometric wall supported by a fixed rigid barrier.

2. INSTALLATION

2.1 Testing ground

The test area shall be large enough to accommodate the run-up track of the mobile deformable barrier, the rigid barrier and the technical equipment necessary for the test. The last part of the track, for at least 5 m before the rigid barrier, shall be horizontal, flat and smooth.

2.2 Fixed rigid barrier and dynamometric wall

2.2.1 The rigid barrier shall consist of a block of reinforced concrete not less than 3 m wide in front and not less than 1.5 m high. The thickness of the rigid barrier shall be such that it weighs at least 70 tonnes. The front face shall be vertical, perpendicular to the axis of the run-up track and covered with load cells capable of measuring the total load on each part of the mobile deformable barrier impactor at the moment of impact. The impact plate area centres shall align with those of the chosen mobile deformable barrier; their edges shall clear adjacent areas by 20 mm. Cell mounting and plate surfaces shall be in accordance with the requirements set out in the annex to ISO 6487:1987. In cases where surface protection is added, it shall not degrade the transducer responses.

2.2.2 The rigid barrier shall be either anchored in the ground or placed on the ground with, if necessary, additional arresting devices to prevent its displacement. A rigid barrier with load cells having different characteristics but giving results that are at least equally conclusive may be used.

3. PROPULSION OF THE MOBILE DEFORMABLE BARRIER

At the moment of impact the mobile deformable barrier shall no longer be subject to the action of any additional steering or propelling device. It shall reach the obstacle on a course perpendicular to the collision barrier. Impact alignment shall be accurate to within 10 mm.

4. MEASURING INSTRUMENTS

4.1 Speed

The impact speed shall be 35 ±2 km/h. The instrument used to record the speed on impact shall be accurate to within one per cent.

4.2 Loads

Measuring instruments shall meet the specifications set forth in ISO 6487:1987

CFC for all blocks	= 60 Hz
CAC for blocks 1 and 3	= 120 kN
CAC for blocks 4, 5 and 6	= 60 kN
CAC for block 2	= 140 kN

4.3 Acceleration

The acceleration in the longitudinal direction shall be measured at a place not subject to bending. The instrumentation shall comply with ISO 6487:1987 with the following specifications:

CFC 1000 Hz (before integration)

CFC 60 Hz (after integration)

CAC 50 g

5. GENERAL SPECIFICATION OF BARRIER

5.1 The individual characteristics of each barrier shall comply with Paragraph 1 of Appendix 2 and shall be recorded.

6. GENERAL SPECIFICATION OF THE IMPACTOR TYPE

6.1 The suitability of an impactor type shall be confirmed when the outputs from the six load cells each produce signals complying with the requirements indicated in Paragraph 2.2 of Appendix 2 when recorded.

6.2 Impactors shall carry consecutive serial numbers including the date of manufacture.

Appendix 3

TECHNICAL DESCRIPTION OF THE SIDE IMPACT DUMMY

1. GENERAL

1.1 The dimensions and masses of the side impact dummy represent a 50th percentile adult male, without lower arms.

1.2 The side impact dummy consists of a metal and plastic skeleton covered by flesh-simulating rubber, plastic and foam.

1.3 The side impact dummy prescribed in this Directive, including the instrumentation and calibration, is described in technical drawings and a user's manual(1)

2. CONSTRUCTION

2.1 For an overview of the side impact dummy see Figure 1 and Table 1 of this Appendix.

2.2. Head

2.2.1 The head is shown as part No. 1 in Figure 1 of this Appendix.

2.2.2 The head consists of an aluminium shell covered by a pliable vinyl skin. The interior of the shell is a cavity accommodating triaxial accelerometers and ballast.

2.3 Neck

2.3.1 The neck is shown as part No. 2 in Figure 1 of this appendix.

2.3.2 The neck consists of a head/neck interface piece, a neck/thorax interface piece and a central section that links the two interfaces to one another.

2.3.3 The head/neck interface piece (part No. 2a) and the neck/thorax interface piece (part No. 2c) both consist of two aluminium disks linked together by means of a half spherical screw and eight rubber buffers.

2.3.4 The cylindrical central section (part No. 2b) is made of rubber.

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(1) Until publication of appropriate ISO Standards these documents (EUROSID-1 User's Manual, dated November 1990) can be obtained from TNO Road Vehicles Research Institute, PO Box 6033, 2600 JA Delft, Schoemakerstraat 97, 2628 VK Delft, The Netherlands.

2.3.5 The neck is mounted on the neck-bracket, shown as part No. 3 in Figure 1 of this appendix.

2.3.6 The angle between the two faces of the neck-bracket is 25 degrees. Because the shoulder block is inclined 5 degrees backwards, the resulting angle between the neck and torso is 20 degrees.

2.4 Shoulder

2.4.1 The shoulder is shown as part No. 4 in Figure 1 of this appendix.

2.4.2 The shoulder consists of a shoulder block, two clavicles and a shoulder cap.

2.4.3 The shoulder block (part No. 4a) consists of an aluminium spacer block, an aluminium plate on top and an aluminium plate on the bottom of the spacer block.

2.4.4 The clavicles (part No. 4b) are made of polypropylene. The clavicles are held back in their neutral position by two elastic cords (part No. 4c) which are clamped to the rear of the shoulder block. The outer edge of both clavicles accommodates a design allowing for standard arm positions.

2.4.5 The shoulder cap (part No. 4d) is made of low-density polyurethane foam and is attached to the shoulder block.

2.5 Thorax

2.5.1 The thorax is shown as part No. 5 in Figure 1 of this appendix.

2.5.2 The thorax consists of a rigid thoracic spine box and three identical rib modules.

2.5.3 The thoracic spine box (part No. 5a) is made of steel. On the rear surface a lead-filled plastic back plate is mounted (part No. 5b).

2.5.4 The top surface of the thoracic spine box is inclined 5 degrees backwards.

2.5.5 A rib module (part No. 5c) consists of a steel rib covered by a flesh-simulating polyurethane foam (part No. 5d), a piston-cylinder assembly (part No. 5e) linking the rib and spine box together, a hydraulic damper (part No. 5f) and a stiff damper spring (part No. 5g).

2.5.6 In the piston-cylinder assembly is a tuning spring (part No. 5h).

2.5.7 A displacement transducer (part No. 5i) can be mounted on the front face of the cylinder and connected to the inside of the rib.

2.6 Arms

2.6.1 The arms are shown as part No. 6 in Figure 1 of this Appendix.

2.6.2 The arms have a plastic skeleton covered by a polyurethane "flesh" and a PVC skin.

2.6.3 The shoulder/arm joint allows for discrete arm positions at 0°, 40° and 90° to the torso line.

2.6.4 The shoulder/arm joint allows for a flexion/extension rotation only.

2.7 Lumbar spine

2.7.1 The lumbar spine is shown as part No. 7 in Figure 1 of this Appendix.

2.7.2 The lumbar spine consists of a solid rubber cylinder with two steel interface plates at each end, and a steel cable inside the cylinder.

2.8 Abdomen

2.8.1 The abdomen is shown as part No. 8 in Figure 1 of this appendix.

2.8.2 The abdomen consists of a metal casting and a polyurethane foam covering.

2.8.3 The central part of the abdomen is a metal casting (part No. 8A). A cover plate is mounted on top of the casting.

2.8.4 The covering (part No. 8b) is made of polyurethane foam. A curved slab of rubber filled with lead-pellets is integrated in the foam covering at both sides.

2.8.5 Between the foam covering and the rigid casting at each side of the abdomen, either three force transducers (part No. 8c) or three non-measuring "dummy" units can be mounted.

2.9 Pelvis

2.9.1 The pelvis is shown as part No. 9 in Figure 1 of this Appendix.

2.9.2 The pelvis consists of a sacrum block, two iliac wings, two hip joints and a foam covering.

2.9.3 The sacrum (part No. 9a) consists of a lead-filled aluminium block and an aluminium plate mounted on top of this block.

2.9.4 The iliac wings (part No. 9b) are made of polyurethane.

2.9.5 The hip joints (part No. 9c) are made of steel. They consist of an upper femur part and a ball joint connected to an axle passing through the dummy's H-point.

2.9.6 The flesh system (part No. 9d) is made of a PVC skin filled with polyurethane foam. At the H-point location the skin is replaced by a large open-cell polyurethane foam cylinder (part No. 9e), attached to a steel plate fixed on the iliac wing by an axle going through the ball joint.

2.9.7 The iliac wings are linked together at the pubic symphysis by a force transducer (part No. 9f) or a "dummy" transducer.

2.10 Legs

2.10.1 The legs are shown as part No. 10 in Figure 1 of this Appendix.

2.10.2 The legs consist of a metal skeleton covered by a flesh-stimulating polyurethane foam and a plastic skin.

2.10.3 The knee and ankle joints allow for a flexion/extension rotation only.

2.11 Suit

2.11.1 The suit is shown as part No. 11 in Figure 1 of this Appendix.

2.11.2 The suit is made of rubber and covers the shoulders, thorax, upper part of the arms, the abdomen and lumbar spine, the upper part of the pelvis.

Figure 1

CONSTRUCTION OF SIDE IMPACT DUMMY

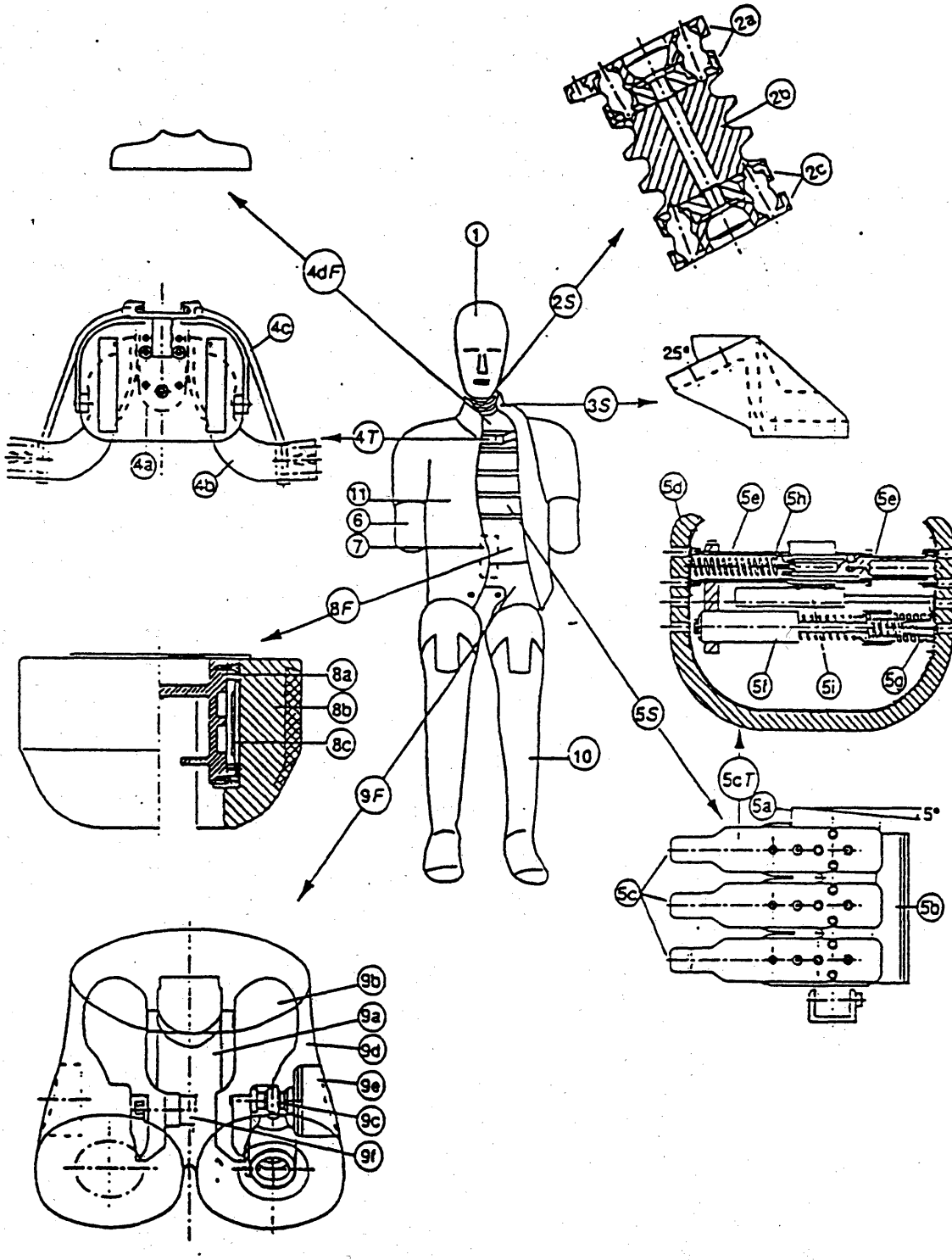


Table 1 - Side Impact Dummy Components

Part No.	Description	Number
1	Head	1
2	Neck	1
2a	Head/neck interface	1
2b	Central section	1
2c	Neck/thorax interface	1
3	Neck-bracket	1
4	Shoulder	1
4a	Shoulder block	1
4b	Clavicles	2
4c	Elastic cord	2
4d	Shoulder cap	1
5	Thorax	1
5a	Thoracic spine	1
5b	Back plate	1
5c	Rib module	3
5d	Rib covered with flesh	3
5e	Piston-cylinder assembly	3
5f	Damper	3
5g	Damper spring	3
5h	Tuning spring	3
5i	Displacement transducer	3
6	Arm	2
7	Lumbar spine	1
8	Abdomen	1
8a	Central casting	1
8b	Flesh covering	1
8c	Force transducer	3
9	Pelvis	1
9a	Sacrum block	1
9b	Iliac wing	2
9c	Hip joint	2
9d	Flesh covering	1
9e	H-point foam block	2
9f	Force transducer	1
10	Leg	2
11	Suit	1

3. ASSEMBLY OF THE DUMMY

3.1 Head-neck

3.1.1 The required torque on the half spherical screws for assembly of the neck is 10 Nm.

3.1.2 The head is mounted to the head-neck interface plate of the neck by three screws.

3.1.3 The neck-thorax interface plate of the neck is mounted to the neck-bracket by four screws.

3.2 Neck-shoulder-thorax

3.2.1 The neck-bracket is mounted to the shoulder block by four screws.

3.2.2 The shoulder-block is mounted to the top-surface of the thoracic spine box by three screws.

3.3 Shoulder-arm

3.3.1 The arms may be mounted to the shoulder clavicles and adjusted by means of a screw and a bearing. The required torque to hold the arm in the defined standard position is 0.6 Nm.

3.4 Thorax-lumbar spine-abdomen

3.4.1 A lumbar spine adaptor is mounted by two screws to the lower part of the thoracic spine.

3.4.2 The lumbar spine adaptor is mounted to the top of the lumbar spine by two screws.

3.4.3 The top flange of the central abdominal casting is clamped between the lumbar spine adaptor and the lumbar spine.

3.5 Lumbar spine-pelvis-legs

3.5.1 The lumbar spine is mounted to the lumbar spine bottom plate by three screws.

3.5.2 The lumbar spine bottom plate is mounted to the sacrum block of the pelvis by three screws.

3.5.3 The legs are mounted to the upper femur - hip joint of the pelvis by a screw.

3.5.4 The legs may be assembled and adjusted by means of hinge joints in the knees and ankles.

4. MAIN CHARACTERISTICS

4.1 Mass

4.1.2 The masses of the main dummy components are presented in Table 2 of this Appendix.

Table 2 - Dummy Component Masses

Component	Mass (kg)	Principal Contents
Head	4.0 ± 0.4	Complete head including triaxial accelerometer
Neck	1.0 ± 0.1	Neck, not including neck-bracket
Thorax	22.4 ± 1.5	Neck bracket, shoulders, arm attachment bolts, spine box, spine back plate, rib modules, rib deflection transducers, lumbar spine adaptor, shoulder cap, abdomen central casting, abdomen force transducers, 2/3 of suit.
Arm	1.3 ± 0.1	Upper arm, including arm positioning plate (each)
Abdomen	5.0 ± 0.5	Abdomen flesh covering and lumbar spine
Pelvis	12.0 ± 1.0	Sacrum block, lumbar spine bottom plate, hip ball joints, upper femurs, iliac wings, pubic force transducer, pelvis flesh covering, 1/3 of suit.
Leg	12.5 ± 1.0	Foot, lower and upper leg and flesh as far as junction with upper femur (each).
Total	72.0 ± 0.5	

4.2. Principal dimensions

4.2.1. The principal dimensions of the side impact dummy (including the suit), based on Figure 2 of this appendix, are given in Table 3 of this appendix.

Figure 2 - Measurements for principal dummy dimensions

(see Table 3)

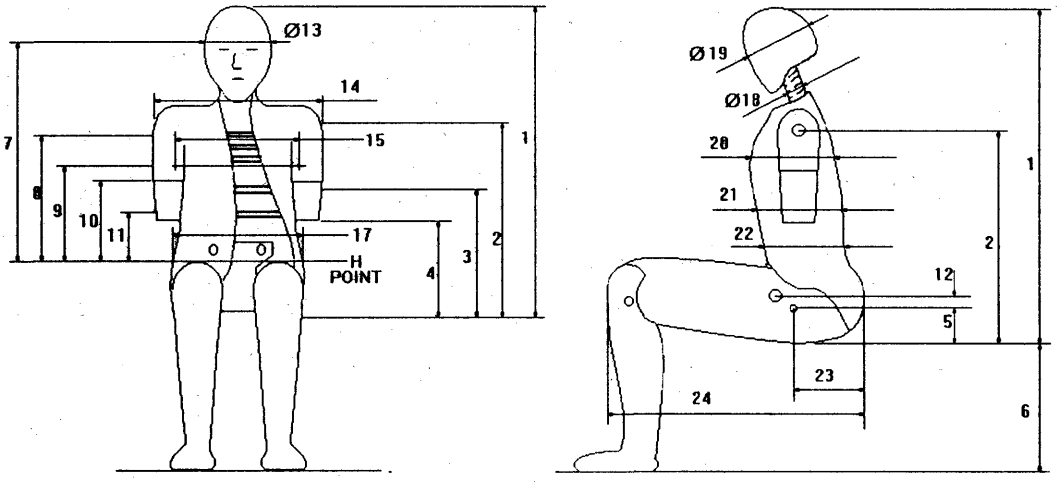


Table 3 - Principal Dummy Dimensions

No.	Parameter	Dimension (mm)
1	Sitting height	904 ± 7
2	Seat to shoulder joint	557 ± 5
3	Seat to bottom lower rib	357 ± 5
4	Seat to arm	242 ± 5
5	Seat to H-point	98 ± 2
6	Sole to seat, sitting	456 ± 5
7	H-point to head C.of.G.	687 ± 5
8	H-point to centre upper rib	393 ± 3
9	H-point to centre middle rib	337 ± 3
10	H-point to centre lower rib	281 ± 3
11	H-point to centre abdominal force transducer	180 ± 3
12	H-point to centre pubic symphysis force transducer	14 ± 2
13	Head width	154 ± 2
14	Shoulder/arm width	482± 5
15	Thorax width	330± 5
16	Abdomen width	290 ± 5
17	Pelvis width	355 ± 5
18	Neck diameter	80 ± 2
19	Head depth	201 ± 5
20	Thorax depth	276 ± 5
21	Abdomen depth	204 ± 5
22	Pelvis depth	245 ± 5
23	Back of buttocks to H-point	157 ± 2
24	Back of buttocks to front knee	610 ± 5

5. CERTIFICATION OF THE DUMMY

5.1 Impact side

5.1.1 Depending on the vehicle side to be impacted, dummy parts should be certified on the left hand side or right hand side.

5.1.2 The configurations of the rib modules (including instrumentation), the abdominal force transducers and the pubic symphysis transducer have to be converted to the required impact side.

5.2 Instrumentation

All instrumentation shall be calibrated in compliance with the requirements of the documentation specified in Paragraph 1.3.

5.2.1 All instrumentation channels shall comply with ISO 6487 : 1987.

5.3 Visual check

5.3.1 All dummy parts should be visually checked for damage and if necessary be replaced before the certification test.

5.4 General test set-up

5.4.1 Figure 3 of this Appendix shows the test set-up for all certification tests on the side impact dummy.

5.4.2 The tests on the head, neck, thorax and lumbar spine are carried out on disassembled parts of the dummy.

5.4.3 The tests on the shoulder, abdomen and pelvis are performed with the complete dummy (without suit). In these tests the dummy is seated on a flat surface with two sheets of less than or equal to 2 mm thick Teflon placed between the dummy and the surface.

5.4.4 All parts to be certified should be kept in the test room for a period of at least four hours at a temperature between 18°C and 22°C prior to a test.

5.4.5 The time between two repeated certification tests should be at least 30 minutes.

5.5 Head

5.5.1 The head is dropped from 200 ± 1 mm onto a flat, rigid impact surface.

5.5.2 The angle between the impact surface and the midsagittal plane of the head is 35° ± 1° allowing an impact of the upper-side of the head.

5.5.3 The peak resultant head acceleration, filtered using CFC 1000, should be between 100 g and 150 g.

5.5.4 The head performance can be adjusted to meet the requirement by altering the friction characteristics of the flesh-skull interface (e.g. by lubrication with talcum powder or PTFE spray).

5.6 Neck

5.6.1 The head-neck interface of the neck is mounted to a special symmetrical certification headform with a mass of 3.9 ± 0.05 kg (see Figure 4).

5.6.2 The headform and neck are mounted upside-down to the bottom of a neck-bending pendulum allowing a lateral motion of the system.

5.6.3 The neck-pendulum is equipped with a uniaxial accelerometer mounted at 1655 ± 5 mm from the pendulum pivot.

5.6.4 The neck-pendulum should be allowed to fall freely from a height chosen to achieve an impact velocity of 3.4 ± 0.1 m/s measured at the accelerometer location.

5.6.5 The neck-pendulum is decelerated from impact velocity to zero by an appropriate device, resulting in a deceleration-time history inside the corridor specified in figure 5 of this annex. All channels have to be recorded using ISO CFC 1000 filters and filtered digitally using CFC 60.

5.6.6 The maximum headform flexion angle relative to the pendulum should be 51 + 5 degrees and should occur between 50 and 62 ms.

5.6.7 The maximum headform centre of gravity displacements in the lateral and vertical direction should be 97 ± 10 mm and 26 ± 6 mm respectively.

5.6.8 The neck performance can be adjusted by replacing the circular section buffers with buffers of a different shore hardness.

5.7 Shoulder

5.7.1 The length of the elastic cord should be adjusted so that a force between 27.5 N and 32.5 N applied in a forward direction 4 ± 1 mm from the outer edge of the clavicle in the same plane as the clavicle movement, is required to move the clavicle forward.

5.7.2 The dummy is seated on a flat, horizontal, rigid surface with no back support. The thorax is positioned vertically and the arms should be set at an angle of 40° ± 2° forward to the vertical. The legs are positioned horizontally.

5.7.3 The impactor is a pendulum of 23.4 ± 0.2 kg and 152 ± 2 mm diameter. The impactor is suspended from a rigid support by four wires with the centre line of the impactor at least 3.5 m below the rigid support.

5.7.4 The impactor is equipped with an accelerometer sensitive in the direction of impact and located on the impactor axis.

5.7.5 The impactor should freely swing onto the shoulder of the dummy with an impact velocity of 4.3 ± 0.1 m/s.

5.7.6 The impact direction is perpendicular to the anterior-posterior axis of the dummy and the axis of the impactor coincides with the axis of the upper arm pivot.

5.7.7 The peak acceleration of the impactor, filtered using CFC 180, should be between 7.5 and 10.5 g.

5.8 Arms

5.8.1 No dynamic certification procedure is defined for the arms.

5.9 Thorax

5.9.1 Each rib module is certified separately.

5.9.2 The rib module is positioned vertically in a drop test rig and the rib cylinder is clamped rigidly onto the rig.

5.9.3 The impactor is a free fall mass of 7.8 ± 0.2 kg with a flat face and a diameter of 150 ± 2 mm.

5.9.4 The centre line of the impactor should be aligned with the centre line of the rib's piston.

5.9.5 The impact velocity is 1.0, 2.0, 3.0 and 4.0 m/s respectively. Impact velocities should not vary from those specified by more than 2 %.

5.9.6 The rib displacement should be measured, for instance using the rib's own displacement transducer.

5.9.7 The rib certification requirements are shown in Table 4 of this Annex.

5.9.8 The performance of the rib module can be adjusted by replacing the tuning spring inside the cylinder with one of a different stiffness.

Table 4 - Certification requirements for the full rib module

Impact velocity (m/s)	Displacement (mm)	
	Minimum	Maximum
1.0	10.0	14.0
2.0	23.5	27.5
3.0	36.0	40.0
4.0	46.0	51.0

5.10 Lumbar spine

5.10.1 The lumbar spine is mounted to the special symmetrical certification headform with a mass of 3.9 ± 0.05 kg (see Figure 4).

5.10.2 The headform and lumbar spine are mounted upside-down to the bottom of a neck-bending pendulum allowing a lateral motion of the system.

5.10.3 The neck-pendulum is equipped with a uniaxial accelerometer mounted at 1655 ± 5 mm from the pendulum pivot.

5.10.4 The neck-pendulum should be allowed to fall freely from a height chosen to achieve an impact velocity of 6.05 ± 0.1 m/s measured at the accelerometer location.

5.10.5 The neck-pendulum is decelerated from impact velocity to zero by an appropriate device, resulting in a deceleration-time history inside the corridor specified in Figure 6 of this annex. All channels have to be recorded using ISO 6487 CFC 1000 filters and filtered digitally using CFC 60.

5.10.6 The maximum headform flexion angle relative to the pendulum should be 50 ± 5 degrees and should occur between 39 and 53 ms.

5.10.7 The maximum headform centre of gravity displacements in the lateral and vertical direction should be 104 ± 7 mm and 33 ± 7 mm respectively.

5.10.8 The performance of the lumbar spine can be adjusted by changing the length of the spine.

5.11 Abdomen

5.11.1 The dummy is seated on a flat, horizontal, rigid surface with no back support. The thorax is positioned vertically, while the arms and legs are positioned horizontally.

5.11.2 The impactor is a pendulum of 23.5 ± 0.2 kg and 152 ± 2 mm diameter.

5.11.3 The pendulum is equipped with a horizontal "armrest" impactor face of 1.0 ± 0.01 kg. The total mass of the impactor with the armrest face is 24.5 ± 0.2 kg. The rigid armrest is 70 ± 1 mm high, 150 ± 1 mm wide and should be allowed to penetrate at least 60 mm into the abdomen. The centre line of the pendulum coincides with the centre of the armrest.

5.11.4 The impactor is equipped with an accelerometer sensitive in the direction of impact and located on the impactor axis.

5.11.5 The impactor should freely swing onto the abdomen of the dummy with an impact velocity of 6.3 ± 0.1 m/s.

5.11.6 The impact direction is perpendicular to the anterior-posterior axis of the dummy and the axis of the impactor is aligned with the centre of the middle force transducer.

5.11.7 The peak force of the impactor, obtained from the impactor acceleration filtered using CFC 180 and multiplied by the impactor/armrest mass, should be between 9.5 and 11.1 kN, and occur between 9.8 and 11.4 ms.

5.11.8 The force-time histories measured by the three abdominal force transducers must be summed and filtered using CFC 600. The peak force of this sum should be between 5.9 and 7.9 kN.

5.12 Pelvis

5.12.1 The dummy is seated on a flat, horizontal, rigid surface with no back support. The thorax is positioned vertically while the arms and legs are positioned horizontally.

5.12.2 The impactor is a pendulum of 23.5 ± 0.2 kg and 152 ± 2 mm diameter.

5.12.3 The impactor is equipped with an accelerometer sensitive in the direction of impact and located on the impactor axis.

5.12.4 The impactor should freely swing onto the pelvis of the dummy with an impact velocity of 4.3 ± 0.1 m/s.

5.12.5 The impact direction is perpendicular to the anterior-posterior axis of the dummy and the axis of the impactor is aligned with the centre of the H-point foam cylinder.

5.12.6 The peak force of the impactor, obtained from the impactor acceleration filtered using CFC 180 and multiplied by the impactor mass, should be between 4.4 and 5.4 kN, and occur between 10.3 and 15.5 ms.

5.12.7 The pubic symphisis force, filtered using CFC 600, should be between 1.04 and 1.64 kN and occur between 9.9 and 15.9 ms.

5.13 Legs

5.13.1 No dynamic certification procedure is defined for the legs.

Figure 3 - OVERVIEW OF THE SIDE IMPACT DUMMY CERTIFICATION TEST SET-UP

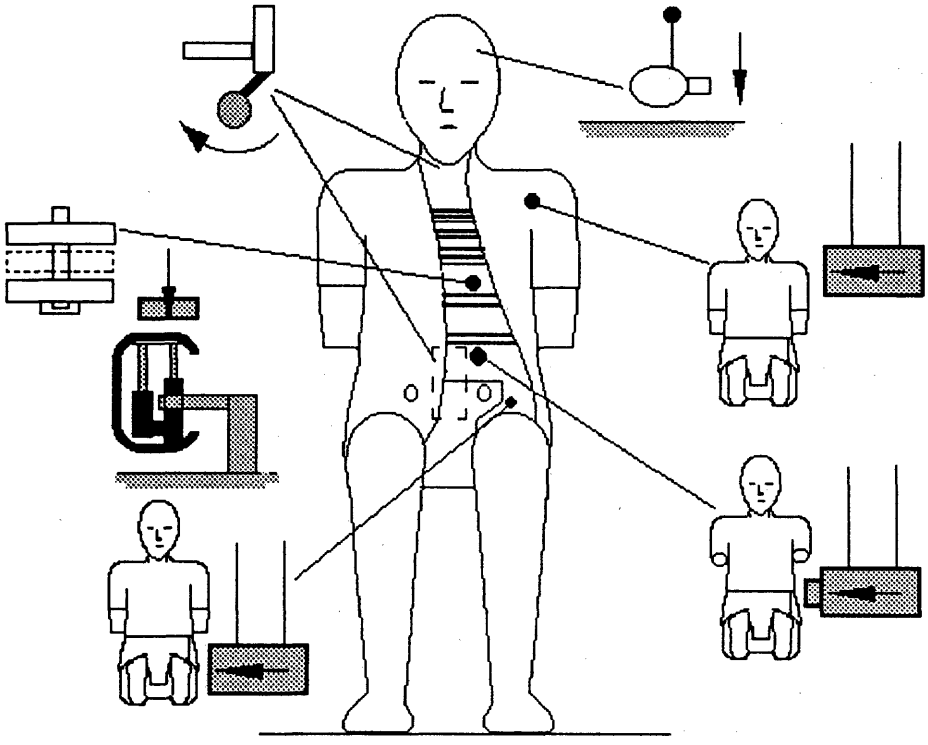


Figure 4 - NECK AND LUMBAR SPINE CERTIFICATION TEST SET-UP

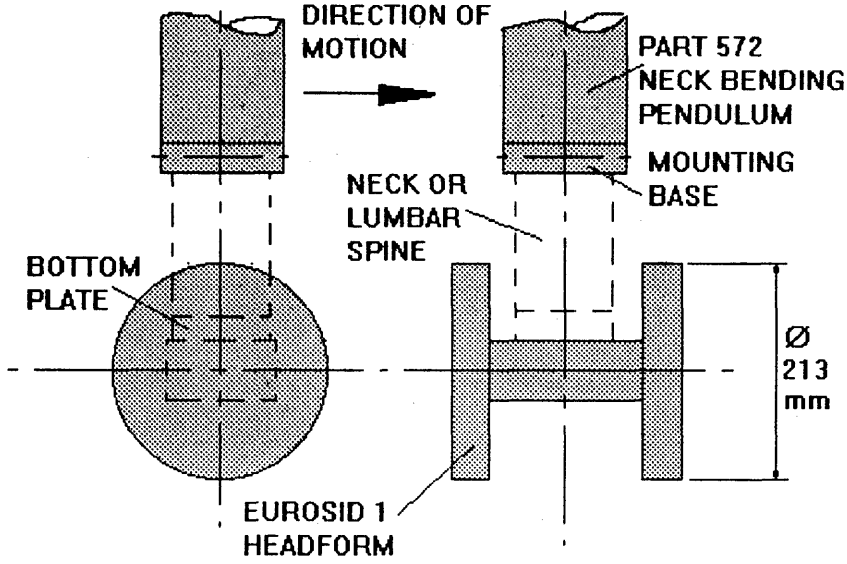


Figure 5 - PENDULUM DECELERATION-TIME CORRIDOR FOR NECK CERTIFICATION TEST

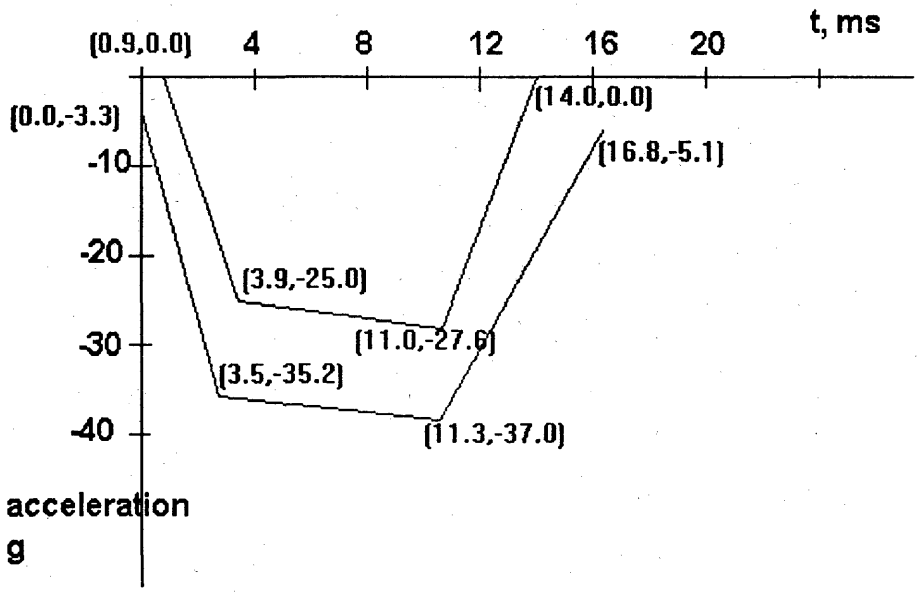
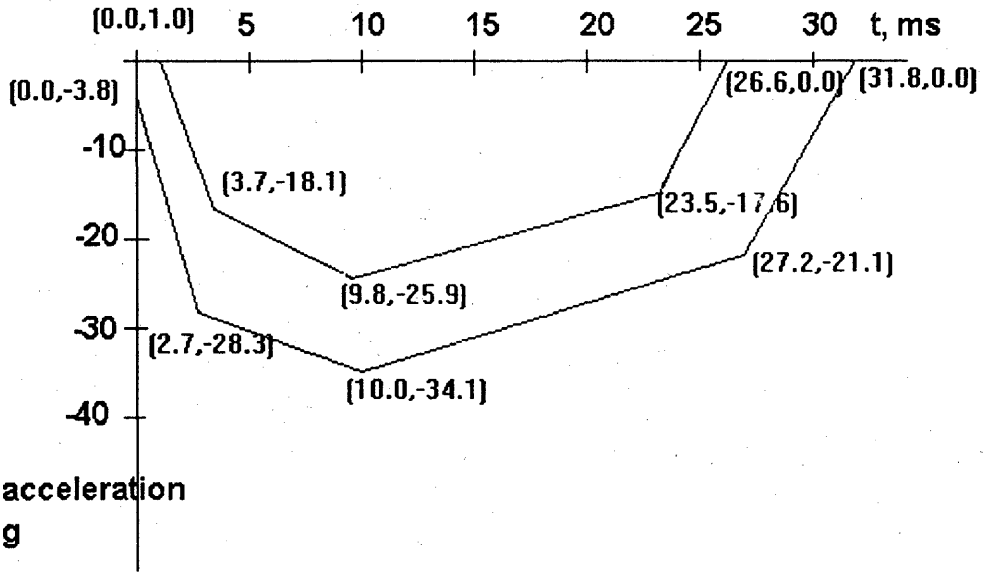


Figure 6 - PENDULUM DECELERATION-TIME CORRIDOR FOR LUMBAR SPINE CERTIFICATION TEST



Appendix 4

INSTALLATION OF THE SIDE IMPACT DUMMY

1. GENERAL

1.1 The side impact dummy to be used for the following installation procedure is described in Appendix 3 of Annex II to this Directive.

2. INSTALLATION

2.1 Adjust the leg joints so that they just support the leg when it is extended horizontally (1 to 2 g).

2.2 Clothe the dummy in form-fitting cotton stretch underwear with short sleeves and mid-calf length trousers. Each foot is equipped with a shoe.

2.3 Place the dummy in the outboard front seat of the impacted side as described in the side impact test procedure specification.

2.4 The plane of symmetry of the dummy shall coincide with the vertical median plane of the specified seating position.

2.5 The pelvis of the dummy shall be positioned such that a lateral line passing through the dummy H-points is perpendicular to the longitudinal centre plane of the seat. The line through the dummy H-points shall be horizontal with a maximum inclination of ± 2 degrees.

2.6 The upper torso shall be bent forward and then laid back firmly against the seat back. The shoulders of the dummy shall be set fully rearward.

2.7 Irrespective of the seating position of the dummy, the angle between the upper arm and the torso arm reference line on each side shall be 40° ± 5°. The torso arm reference line is defined as the intersection of the plane tangential to the front surface of the ribs and the longitudinal vertical plane of the dummy containing the arm.

2.8 For the driver's seating position, without inducing pelvis or torso movement, place the right foot of the dummy on the undepressed accelerator pedal with the heel resting as far forward as possible on the floorpan. Set the left foot perpendicular to the lower leg with the heel resting on the floorpan in the same lateral line as the right heel. Set the knees of the dummy such that their outside surfaces are 150 ± 10 mm from the plane of symmetry of the dummy. If possible within these constraints place the thighs of the dummy in contact with the seat cushion.

2.9 For other seating positions, without inducing pelvis or torso movement, place the heels of the dummy as far forward as possible on the floorpan without compressing the seat cushion more than the compression due to the weight of the leg. Set the knees of the dummy such that their outside surfaces are 150 ± 10 mm from the plane of symmetry of the dummy.

Appendix 5

PARTIAL TEST

1. PURPOSE

The purpose of these tests is to verify whether the modified vehicle presents at least the same (or better) energy absorption characteristics than the vehicle type approved under this Directive.

2. PROCEDURES AND INSTALLATIONS

2.1 Reference tests

2.1.1 Using the initial padding materials tested during the approval of the vehicle, mounted in a new lateral structure of the vehicle to be approved, two dynamic tests, utilising two different impactors shall be carried out (Figure 1).

2.1.1.1 The head form impactor, defined in Paragraph 3.1.1, shall hit at 24.1 km/h, in the area impacted for the EUROSID head during the approval of the vehicle. Test result shall be recorded, and the HPC calculated. However, this test shall not be carried out when, during the tests described in Appendix 1 of Annex II to this Directive:

there has been no head contact, or

the head contacted the window glazing only, provided that the window glazing is not laminated glass.

2.1.1.2 The body block impactor, defined in Paragraph 3.2.1, shall hit at 24.1 km/h in the lateral area impacted by the EUROSID shoulder, arm and thorax, during the approval of the vehicle. Test result shall be recorded, and the HPC calculated.

2.2 Approval test

2.2.1 Using the new padding materials, seat, etc. presented for the approval extension, and mounted in a new lateral structure of the vehicle, tests specified in Paragraphs 2.1.1.1 and 2.1.1.2, shall be repeated, the new results recorded, and their HPC calculated.

2.2.1.1 If the HPC calculated from the results of both approval tests are lower than the HPC obtained during the reference tests (carried out using the original type approved padding materials or seats), the extension shall be granted.

2.2.1.2 If the new HPC are greater than the HPC obtained during the reference tests, a new full scale test (using the proposed padding/seats/etc.) shall be carried out.

3. TEST EQUIPMENT

3.1 Head form impactor (Figure 1)

3.1.1 This apparatus consists of a fully guided linear impactor, rigid, with a mass of 6.8 kg. Its impact surface is hemispherical with a diameter of 165 mm.

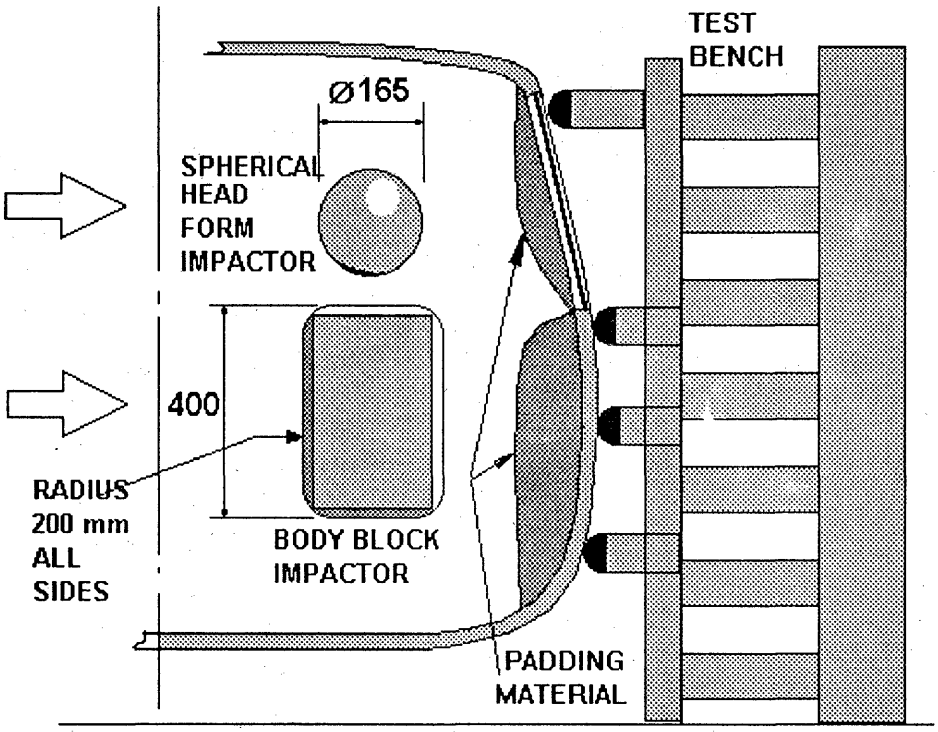
3.1.2 The head form shall be fitted with two accelerometers and a speed-measuring device, all capable of measuring values in the impact direction.

3.2 Body block impactor (Figure 1)

3.2.1 This apparatus consists of a fully guided linear impactor, rigid, with a mass of 30 kg. Its dimensions and transversal section is presented in Figure 1.

3.2.2 The body block shall be fitted with two accelerometers and a speed-measuring device, all capable of measuring values in the impact direction.

Figure 1



IMPACT STATEMENT ON COMPETITIVENESS AND JOBS

Draft Council and Parliament Directive introducing provisions for the side-impact resistance of motor vehicles and amending directive 70/156/EEC in respect of the type approval of motor vehicles and their trailers.

I. What is the main justification of the measure?

the reduction in serious and fatal injuries sustained by occupants of motor vehicles and the harmonisation of national laws.

II. Characteristics of the companies involved. More particularly:

Do they include a large number of small and medium-sized businesses? *No*

Are there any significant concentrations in regions:

- eligible for Member State regional aid? *No*
- eligible under the European Regional Development Fund? *No*

III. What obligations are imposed on those companies?

To incorporate modifications to the side structure of new vehicle designs to withstand the impacting forces envisaged in this test procedure.

IV. What obligations are likely to be imposed indirectly upon those companies via the local authorities?

No additional obligation.

V. Do any special measures apply to small and medium-sized businesses? *No*

VI. What is the foreseeable outcome:

- on company productivity? *No foreseeable effect.*
- on jobs? *No foreseeable effect.*

VII. Have both sides of industry been consulted? *Yes*

Opinion of both sides of industry: *Subject to appropriate lead times, industry could accept these measures.*

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