GHANA STANDARDS AUTHORITY

GHANA STANDARD

DGS 4012:2019

ECE 12R04:2012

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO THE PROTECTION OF THE DRIVER AGAINST THE STEERING MECHANISM IN THE EVENT OF IMPACT

(UNECE 12R04 Rev. 2 – 23 March 1983, IDT)

This document is a Draft Ghana Standard. This document shall not be used or referred to as a Ghana Standard

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Foreword

The Ghana Standards Authority is the National Statutory Body responsible for the development and promulgation of Ghana Standards.

The Ghana Standards Authority is a member of the African Organization for Standardization (ARSO), the International Organization for Standardization (ISO) and an affiliate member of the International Electrotechnical Commission (IEC).

This Ghana Standard is an identical adoption of the *UNECE 12R02 Rev. 4 – 23 March 1983– Uniform provisions concerning the approval of vehicles with regard to the protection of the driver against the steering mechanism in the event of impact* and lays down the essential requirements to which such steering mechanism must conform.

Throughout the text of this standard, read "…this UNECE Regulation…" to mean "…this Ghana Standard…"

The National Committee responsible for this standard (DGS 4012:2019) is the Technical Committee on Automobile Industry (GSA/TC 05).

This is the 1st edition.

Users of this standard should note that the standard undergoes revision from time to time and any references to it statutorily imply its latest edition.

~~E/ECE/324~~
E/ECE/TRANS/505 } Add.11/Rev.2
23 March 1983

UNITED NATIONS

AGREEMENT

CONCERNING THE ADOPTION OF UNIFORM CONDITIONS OF APPROVAL AND RECIPROCAL RECOGNITION OF APPROVAL FOR MOTOR VEHICLE EQUIPMENT AND PARTS

done at Geneva on 20 March 1958

Addendum 11: Regulation No. 12 to be annexed to the Agreement

Revision 2

Incorporating the 02 series of amendments which entered into force on 14 November 1982

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO THE PROTECTION OF THE DRIVER AGAINST THE STEERING MECHANISM IN THE EVENT OF IMPACT

Regulation No. 12

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Regulation No. 12

UNIFORM PROVISIONS CONCERNING THE APPROVAL OF VEHICLES WITH REGARD TO THE PROTECTION OF THE DRIVER AGAINST THE STEERING MECHANISM IN THE EVENT OF IMPACT

1. SCOPE

This Regulation applies to the behaviour of the steering mechanism of private (passenger) cars of categories M_1, M_1(a) and M_1(b), other than forward-control vehicles, when subjected to two types of forces, viz.:

1.1. forces produced by a head-on collision which may cause movement of the steering control;

1.2. forces due to the inertia of the mass of the driver in the event of impact against the steering control in a head-on collision.

1.3. At the request of a manufacturer vehicles belonging to other categories may be approved under this Regulation.

2. DEFINITIONS

For the purposes of this Regulation,

2.1. "approval of a vehicle" means the approval of a vehicle type with regard to the protection of the driver against the steering mechanism in the event of impact;

2.2. "vehicle type" means a category of motor vehicles which do not differ in such essential respects as:

2.2.1. the structure, dimensions, lines and constituent materials of that part of the vehicle forward of the steering control;

2.2.2. unladen weight, as defined in paragraph 2.10. below;

2.3. "approval of a steering control" means the approval of a steering control type with regard to the protection of the driver against the steering mechanism in the event of impact;

2.4. "steering control type" means a category of steering controls which do not differ in such essential respects as:

2.4.1. the structure, dimensions, lines and constituent materials;

2.5. "steering control" means the steering device, usually the steering wheel, which is actuated by the driver;

2.6. "steering column" means the housing enclosing the steering shaft;

2.7. "steering shaft" means the component which transmits to the steering gear the torque applied to the steering control;

2.8. "steering mechanism" means the aggregate comprising the steering control, the steering column, the assembly accessories, the steering shaft, the steering gear housing, and all other components such as those designed to contribute to the absorption of energy in the event of impact against the steering control;

2.9. "general steering control" means a steering control which can be fitted to more than one approved vehicle type where differences in the attachment of the steering control to the steering column do not affect the impact performance of the steering control;

2.10. "unladen weight" means the weight of the vehicle in running order, unoccupied and unladen but complete with fuel, coolant, lubricant, tools and spare wheel, if provided as standard equipment by the vehicle manufacturer;

2.11. "forward-control vehicle" means a vehicle in which the centre of the steering wheel is in the forward quarter of the vehicle's total length (including bumpers and over-riders, if any);

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

3. APPLICATION FOR APPROVAL

3.1. Vehicle type

3.1.1. The application for approval of a vehicle type with regard to the protection of the driver against the steering mechanism in the event of impact shall be submitted by the vehicle manufacturer or by his duly accredited representative.

3.1.2. It shall be accompanied by the undermentioned documents in triplicate and the following particulars:

3.1.2.1. a detailed description of the vehicle type with respect to the structure, dimensions, lines and constituent materials of that part of the vehicle forward of the steering control;

3.1.2.2. drawings, on an appropriate scale and in sufficient detail, of the steering mechanism and of its attachment to the vehicle chassis and body;

3.1.2.3. a technical description of that mechanism;

3.1.2.4. an indication of the unladen kerb weight of the vehicle;

3.1.2.5. evidence that the steering control has been approved in accordance with paragraph 5.2 of this Regulation, if applicable.

3.1.3. The following shall be submitted to the technical service responsible for conducting approval tests;

3.1.3.1. a vehicle, representative of the vehicle type to be approved, for the test referred to in paragraph 5.1. below;

3.1.3.2. at the manufacturer's discretion, with the agreement of the technical service, either a second vehicle, or those parts of the vehicle regarded by him as essential for the test referred to in paragraph 5.2. below.

3.2. Steering control type

3.2.1. The application for approval of a steering control type with regard to the protection of the driver against the steering mechanism in the event of an impact shall be submitted by the steering control manufacturer or by his duly accredited representative.

3.2.2. It shall be accompanied by the undermentioned documents in triplicate and the following particulars:

3.2.2.1. a detailed description of the steering control type with respect to the structure, the dimensions and the constituent materials of the steering control;

3.2.2.2. drawings, on an appropriate scale and in sufficient detail, of the steering mechanism and of its attachment to the vehicle chassis and body.

3.3. A steering control representative of the steering control type to be approved plus, at the manufacturer's discretion, with the agreement of the technical service, those parts of the vehicle regarded by him as essential for the test, shall be submitted to the technical service responsible for conducting approval tests for the test referred to in paragraph 5.2. below.

4. APPROVAL

4.1. Vehicle type

4.1.1. If the vehicle submitted for approval pursuant to this Regulation meets the requirements of paragraphs 5. and 6. below, approval of that vehicle type shall be granted.

4.1.2. An approval number shall be assigned to each type approved. Its first two digits (at present 02 corresponding to the 02 series of amendments entered into force on 14 November 1982) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to the same vehicle type equipped with another type of steering mechanism, or to another vehicle type, as defined in paragraph 2.2. above.

4.1.3. Notice of approval or of refusal of approval of a vehicle type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annex 1A to this Regulation and of drawings of the steering mechanism supplied by the applicant for approval, in a format not exceeding A 4 (210 x 297 mm) or folded to that format and on appropriate scale.

4.1.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every vehicle conforming to a vehicle type approved under this Regulation an international approval mark consisting of:

4.1.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;[1/]

4.1.4.2. the number of this Regulation, followed by the letter "R", a dash and the approval number to the right of the circle prescribed in paragraph 4.1.4.1.

4.1.5. If the vehicle conforms to a vehicle type approved, under one or more other Regulations annexed to the Agreement, in the country which has granted approval under this Regulation, the symbol prescribed in paragraph 4.1.4.1. need not be repeated; in such a case the Regulation and approval numbers and the additional symbols of all the Regulations under which approval has been granted in the country which has granted approval under this Regulation shall be placed in vertical columns to the right of the symbol prescribed in paragraph 4.4.1.

1/ 1 for the Federal Republic of Germany, 2 for France, 3 for Italy, 4 for the Netherlands, 5 for Sweden, 6 for Belgium, 7 for Hungary, 8 for Czechoslovakia, 9 for Spain, 10 for Yugoslavia, 11 for the United Kingdom, 12 for Austria, 13 for Luxembourg, 14 for Switzerland, 15 for the German Democratic Republic, 16 for Norway, 17 for Finland, 18 for Denmark, 19 for Romania, 20 for Poland and 21 for Portugal. Subsequent numbers shall be assigned to other countries in the chronological order in which they ratify or accede to the Agreement concerning the Adoption of Uniform Conditions of Approval and Reciprocal Recognition of Approval for Motor Vehicle Equipment and Parts, and the numbers thus assigned shall be communicated by the Secretary-General of the United Nations to the Contracting Parties to the Agreement.

4.1.6. The approval mark shall be clearly legible and be indelible.

4.1.7. The approval mark shall be placed close to or on the vehicle data plate affixed by the manufacturer.

4.2. Steering-control type

4.2.1. If the steering control submitted for separate approval pursuant to this Regulation meets the requirements of paragraphs 5.2. and 6. below and annexes 4, 5.and 6 to this Regulation, approval of that steering control type shall be granted.

4.2.2. An approval number shall be assigned to each type approved. Its first two digits (at present 02 corresponding to the 02 series of amendments entered into force on 14 November 1982) shall indicate the series of amendments incorporating the most recent major technical amendments made to the Regulation at the time of issue of the approval. The same Contracting Party shall not assign the same number to another steering control type as defined in paragraph 2.4. above.

4.2.3. Notice of approval or of refusal of approval of a steering control type pursuant to this Regulation shall be communicated to the Parties to the Agreement applying this Regulation, by means of a form conforming to the model in annex 1B to this Regulation and of drawings of the steering mechanism supplied by the applicant for approval, in a format not exceeding A4 (210 x 297 mm) or folded to that format and on an appropriate scale.

4.2.4. There shall be affixed, conspicuously and in a readily accessible place specified on the approval form, to every steering control conforming to a steering control type approved under this Regulation an international approval mark consisting of:

4.2.4.1. a circle surrounding the letter "E" followed by the distinguishing number of the country which has granted approval;

4.2.4.2. the approval number placed below the circle.

4.2.5. The approval mark shall be clearly legible and be indelible.

4.2.6. Annex 2 to this Regulation gives examples of arrangements of approval marks.

5. SPECIFICATIONS

5.1. When the unladen car, in running order, without a manikin, is collision-tested against a barrier at a speed of 48.3 km/h (30 mph), the top of the steering column and its shaft shall not move backwards, horizontally[2/] and parallel to the longitudinal axis of the vehicle, by more than 12.7 cm in relation to a point of the vehicle not affected by the impact.

5.2. When the steering control is struck by a body block released against this control at a relative speed of 24.1 km/h (15 mph), the force applied to the body block by the steering control shall not exceed 1.111 daN.

5.3. The steering control shall be so designed, constructed and fitted as not to comprise either any dangerous roughness or sharp edges likely to increase the danger or severity of injuries to the driver in the event of impact.

5.3.1. A steering control is considered to meet the above conditions if:

5.3.1.1. no part of its surface, directed towards the driver which can be contacted by a sphere of diameter of 165 mm, presents any roughness or sharp edges with a radius of curvature of less than 2.5 mm; after any impact test required in paragraphs 5.1. and 5.2., the parts of its surface directed towards the driver shall not present any sharp or rough edges likely to increase the danger or severity of injuries to the driver. Small surface cracks and fissures shall be disregarded;

5.3.1.1.1. in the case of a projection consisting of a component made of non-rigid material of less than 50 Shore A hardness mounted on rigid support, the requirement of paragraph 5.3.1.1. shall only apply to the rigid support.

5.3.2. The steering control shall be so designed, constructed and fitted as not to embody components or accessories, including the horn control and assembly accessories, capable of catching in the driver's clothing or jewellery in normal driving movements.

5.3.3. In the case of steering controls not intended to form part of the original equipment and if they are tested by themselves, the maximum force shall not exceed the maximum force as measured on the original equipment for the approved vehicle type when tested under similar conditions.

2/ "Horizontally" means with reference to the passenger compartment when the vehicle is immobile before the test, not in space during movement of the vehicle in relation to the ground.

5.3.4. In the case of "general steering controls", the requirements shall be met over:

5.3.4.1. the full range of column angles, it being understood that the tests shall be performed at least for the maximum and minimum column angles for the range of approved vehicle types for which the controls are intended;

5.3.4.2. the full range of possible body block positions in relation to the steering control, it being understood that the test shall be performed at least for the mean position for the range of approved vehicle types for which the controls are intended. Where a steering column is used, it shall be of a type corresponding to the "worst case" conditions.

5.3.5. Where adaptors are used to adapt a single type of steering control to a range of steering column, and it can be demonstrated that with such adaptors the energy-absorbing characteristics of the system are the same, all the tests may be performed with one type of adaptor.

6. TESTS

6.1. Compliance with the requirements of paragraph 5. above shall be checked in accordance with the methods set out in annexes 3, 4 and 6 to this Regulation. The **test** prescribed in annex 4 shall not be carried out if the steering wheel is energy-absorbing in accordance with the provisions of annex 5.

6.2. However, other tests may be permitted at the discretion of the Approval Authority provided equivalence can be demonstrated. In such a case a report shall be attached to the approval documentation describing the methods used and the results obtained.

7. MODIFICATIONS OF THE VEHICLE TYPE OR STEERING CONTROL TYPE

7.1. Every modification of the vehicle type or steering control type or both shall be notified to the administrative department which approved the vehicle type or the steering control type. The department may then either:

7.1.1. consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements; or

7.1.2. require a further test report from the technical service responsible for conducting the tests.

7.2. Without prejudice to the provisions of paragraph 7.1. above, a variant of the vehicle whose unladen weight is less than that of the vehicle subjected to the approval test shall not be regarded as a modification of the vehicle type.

7.3. Confirmation or refusal of approval, specifying the alteration shall be communicated by the procedure specified in paragraph 4.1.3. above to the Parties to the Agreement applying this Regulation.

8. CONFORMITY OF PRODUCTION

8.1. Every vehicle bearing an approval mark as prescribed under this Regulation shall conform to the vehicle type approved, more particularly as regards features contributing to the protection of the driver against the steering mechanism in the event of impact.

8.2. In order to verify conformity as prescribed in paragraph 8.1. above, a sufficient number of random checks shall be made on serially-manufactured vehicles bearing the approval mark required by this Regulation.

8.3. Every steering control bearing an approval mark as prescribed under this Regulation shall conform to the steering control type approved.

8.4. In order to verify conformity as prescribed in paragraphs 8.3. above, a sufficient number of random checks shall be made on serially-produced steering controls bearing the approval mark required by this Regulation.

8.5. As a general rule these checks shall be confined to the taking of measurements. However, if necessary, the vehicles or the steering controls shall be subjected to certain checks as prescribed in paragraph 5 above.

9. PENALTIES FOR NON-CONFORMITY OF PRODUCTION

9.1. The approval granted in respect of a vehicle type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8.1. above are not complied with, or if the vehicle fails to pass the test prescribed in paragraph 5. above.

9.2. The approval granted in respect of a steering control type pursuant to this Regulation may be withdrawn if the requirements laid down in paragraph 8.3. above are not complied with, or if the steering control fails to pass the test provided for in paragraph 5.2. above.

9.3. If a Party to the Agreement applying this Regulation withdraws an approval it has previously granted, it shall forthwith so notify the other Contracting Parties applying this Regulation, by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation "APPROVAL WITHDRAWN".

10. INSTRUCTIONS

In the case of a steering control type supplied separately from a vehicle, the packaging and installation instructions must clearly state the vehicle type(s) for which it is intended.

11. PRODUCTION DEFINITELY DISCONTINUED

If the holder of the approval completely ceases to manufacture a type of vehicle or type of steering control approved in accordance with this

Regulation, he shall so inform the authority which granted the approval. Upon receiving the relevant communication that authority shall inform thereof the other Parties to the Agreement which apply this Regulation by means of a copy of the approval form bearing at the end, in large letters, the signed and dated annotation: "PRODUCTION DISCONTINUED".

12. NAMES AND ADDRESSES OF TECHNICAL SERVICES RESPONSIBLE FOR CONDUCTING APPROVAL TESTS, AND OF ADMINISTRATIVE DEPARTMENTS

The Parties to the Agreement applying this Regulation shall communicate to the United Nations Secretariat the names and addresses of the technical services responsible for conducting approval tests and of the administrative departments which grant approval and to which forms certifying approval or refusal or withdrawal of approval, issued in other countries, are to be sent.

13. TRANSITIONAL PROVISIONS

13.1. Contracting Parties applying Regulation No. 12 may continue to grant type approvals under this Regulation amended by the 01 series of amendments (E/ECE/324-TRANS/505/Add.11/Rev.1) not later than one year after entry into force of the 02 series of amendments to this Regulation.

13.2. Approvals granted under this Regulation amended by the 01 series of amendments shall cease to be valid four years after the entry into force of the 02 series of amendments to this Regulation unless the Contracting Party, which has granted the approval, notifies the other Contracting Parties applying this Regulation that the vehicle type or steering control type approved also meets the requirements of this Regulation as amended by the 02 series of amendments.

Annex 1A

(Maximum format: A 4 (210 x 297 mm))

Name of administration

Communication concerning the approval (or refusal or withdrawal of approval or production definitely discontinued) of a vehicle type with regard to the protection of the driver against the steering mechanism in the event of impact, pursuant to Regulation No. 12.

Approval No. .....

1. Trade name or mark of the motor vehicle .....
2. Vehicle type .....
3. Manufacturer's name and address .....
4. If applicable, name and address of the manufacturer's representative .....
   .....
5. Brief description of the steering mechanism and the components of the vehicle contributing to the protection of the driver against the steering mechanism in the event of impact .....
   .....
6. Weight of the vehicle during the test .....
   front axle: .....
   rear axle: .....
   total: .....
7. Maximum force measured during the test .....
8. Vehicle submitted for approval on .....
9. Technical service responsible for conducting approval tests .....
10. Date of report issued by that service .....
11. Number of report issued by that service .....
12. Approval granted/refused*/
13. Position of approval mark on the vehicle .....
    .....

*/ Strike out what does not apply.

14. Place .....

15. Date .....

16. Signature .....

17. The following documents, bearing the approval number shown above, are annexed to this communication:

..... drawings, diagrams and plans of the steering mechanism;

..... photographs of the steering mechanism and other components contributing to the protection of the driver against the steering mechanism in the event of impact.

Annex 1B

(Maximum format: A4 (210 x 297 mm))

Name of administration

Communication concerning the approval (or refusal or withdrawal of approval or production definitely discontinued) of a steering control type with regard to the protection of the driver against the steering mechanism in the event of impact, pursuant to the relevant part of Regulation No. 12.

Approval No. .....

1. Trade name or mark of the steering control
.....
2. Manufacturer's name and address .....
.....
3. If applicable, name and address of the manufacturer's representative
.....
4. Vehicle type(s) to which the control is intended to be fitted
.....
5. Brief description of the steering mechanism and the components of the vehicle contributing to the protection of the driver against the steering mechanism in the event of impact .....
.....
6. Steering control submitted for approval on .....
.....
7. Technical service responsible for conducting approval tests .....
.....
8. Date of report issued by that service .....
9. Number of report issued by that service .....
.....
10. Approval granted/refused*/
11. Position of approval mark or marks on the steering control .....
.....

*/ Strike out what does not apply.

12. Place .....

13. Date .....

14. Signature .....

15. The following documents, bearing the approval number shown above, are annexed to this communication:

..... drawings, diagrams and plans fo the steering mechanism;

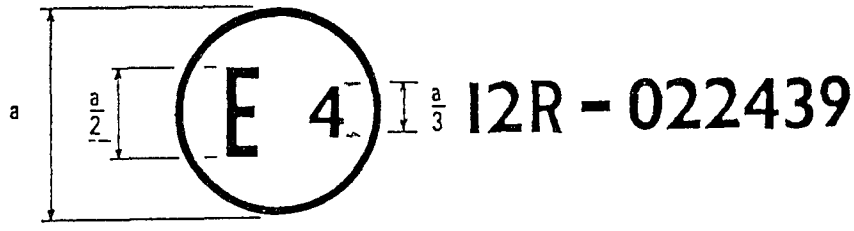
..... photographs of the steering mechanism and other components contributing to the protection of the driver against the steering mechanism in the event of impact.

Annex 2

ARRANGEMENTS OF APPROVAL MARKS

Model A

(See paragraph 4.1.4. of this Regulation)

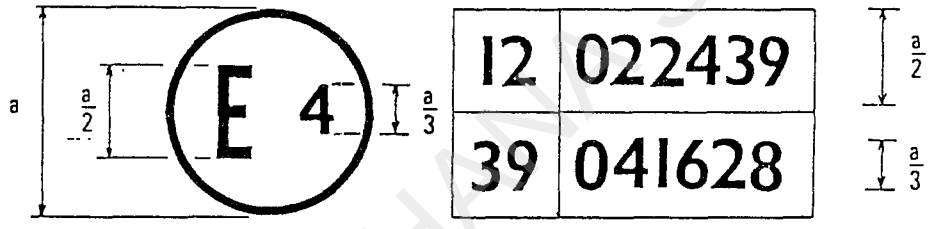


a = 8mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has, with regard to the protection of the driver against the steering mechanism in the event of impact, been approved in the Netherlands (E 4) pursuant to Regulation No. 12. The approval number indicates that the approval was granted according to the requirements of Regulation No. 12 as amended by the 02 series of amendments.

Model B

(See paragraph 4.1.5. of this Regulation)

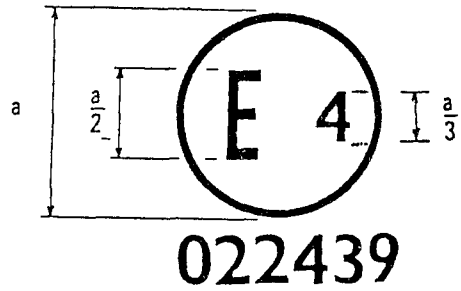


a = 8mm min.

The above approval mark affixed to a vehicle shows that the vehicle type concerned has been approved in the Netherlands (E 4) pursuant to Regulations Nos. 12 and 39. */ The approval numbers indicate that, at the dates when the respective approvals were given, Regulation No. 12 included the 02 series of amendments and Regulation No. 39 the 04 series of amendments.

Model C

(See paragraph 4.2.4. of this Regulation)



a = 8mm min.

The above approval mark affixed to a steering control shows that the steering control type concerned has, with regard to the protection of the driver against the steering mechanism in the event of impact, been approved in the Netherlands (E 4) pursuant to the relevant part of Regulation No. 12.

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*/ The second number is given merely as an example.

Annex 3

FRONTAL-IMPACT TEST AGAINST A BARRIER

1. Scope

This method is not applicable to vehicles weighing more than 3.5 metric tons.

2. Installations, procedure and measuring instruments

2.1. Testing ground

The test area shall be large enough to accommodate the run-up track, barrier and technical installations necessary for the test. The last part of the track, for at least 5 m before the barrier, shall be horizontal (slope less than 3 per cent measured over a length of one metre), flat and smooth.

2.2. Barrier

The 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 barrier shall be of such thickness that it weighs at least 70 metric tons. The front face shall be flat, vertical and perpendicular to the axis of the run-up track. It shall be covered with plywood boards 19 ± 1 mm thick, in good condition. A structure on a steel plate at least 25 mm thick may be placed between the plywood board and the barrier. A barrier with different characteristics may likewise be used, provided that the area of the impact surface is greater than the frontal crash area of the vehicle being tested and provided that it gives equivalent results.

2.3. Propulsion of vehicle

At the moment of impact the vehicle 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 wall; the maximum lateral misalignment tolerated between the vertical median line of the front of the vehicle and the vertical median line of the collision wall is ± 30 cm.

2.4. State of vehicle

2.4.1. For the test, the vehicle shall either be fitted with all the normal components and equipment included in its unladen kerb weight or be in such a condition as to satisfy this requirement so far as the components and equipment of concern to the passenger compartment and the distribution of the weight of the vehicle as a whole, in running order, are concerned.

At the request of the manufacturer, by derogation from paragraph 5.1. of this Regulation, the test may be carried out with manikins in position, provided they do not at any time hinder the movement of the steering mechanism. The weight of the manikins shall not be taken into account for the purposes of the test.

2.4.2. If the vehicle is driven by external means, the fuel feed system shall be filled to at least 90 per cent of its capacity with a non-inflammable liquid having a density between 0.7 and 1. All the other systems (brake-fluid reservoirs, radiator, etc.) may be empty.

2.4.3. If the vehicle is driven by its own engine, the fuel tank shall be at least 90 per cent full. All other reservoirs shall be filled to capacity.

If the manufacturer so desires and the technical service agrees, the fuel feed to the engine may be provided from an auxiliary tank of small capacity. In such case, the fuel tank shall be filled to not less than 90 per cent of its capacity with a non-inflammable liquid of a density between 0.7 and 1.

2.4.4. If the manufacturer so requests, the technical service responsible for conducting the tests may allow the same vehicle as is used for tests prescribed by other Regulations (including tests capable of affecting its structure) to be used also for the tests prescribed by this Regulation.

2.5. Speed on impact

The speed on impact shall be between 48.3 km/h (30 mph) and 53.1 km/h (33 mph). However, if the test has been carried out at a higher impact speed and the vehicle has met the requirements laid down, the test shall be considered satisfactory.

2.6. Measuring instruments

The instrument used to record the speed referred to in paragraph 2.5. above shall be accurate to within 1 per cent.

3. Results

3.1. To determine the rearward movement of the steering control, a recording shall be made,[1/] during the collision, of the variation in the distance - measured horizontally and parallel to the longitudinal axis of the vehicle - between the top of the steering column (and shaft) and a point on the vehicle which is not affected by the impact. The largest value of this variation, taken from the recording, shall be taken as the rearward movement.

3.2. After the test, the damage sustained by the vehicle shall be described in a written report; one photograph at least shall be taken of each of the following views of the vehicle:

3.2.1. sides (right and left),

3.2.2. front,

3.2.3. bottom,

3.2.4. affected area inside the passenger compartment.

4. Correction factors

4.1. Notation

V Recorded speed in km/h;

m_o Weight of prototype in the state defined in paragraph 2.4. of this annex;

m_1 Weight of prototype with testing apparatus;

D_o Variation in the distance measured during the impact, as defined in paragraph 3.1. of this annex;

D_1 Variation in the distance used to determine the results of the test;

K_1 = the greater of $\left(\frac{48.3}{V}\right)^2$ and 0.83;

K_2 = the greater of $\frac{m_o}{m_1}$ and 0.8.

4.2. The corrected variation D_1 used to check the conformity of the prototype with the requirements of this Regulation shall be calculated by the following formula:

$$D_1 = D_o . K_1 . K_2$$

1/ This recording may be replaced by maximum and minimum measurements.

4.3. A frontal impact test against a barrier is not needed in the case of a vehicle which is identical with the prototype considered as regards the characteristics specified in paragraph 2.2. of this Regulation but whose weight m_1 is greater than m_o, if m_1 is not more than 1.25 m_o and if the corrected variation D_2 obtained from the variation D_1 by the formula $D_2 = \frac{m_1}{m_o} . D_1$ is such as to show that the new vehicle still meets the requirements of paragraph 5. of this Regulation.

Annex 4

TEST FOR ENERGY ABSORPTION CAPACITY IN THE EVENT OF IMPACT AGAINST THE STEERING CONTROL

1. Purpose

The purpose of this test is to verify whether the vehicle meets the requirements set out in paragraph 5.2. of this Regulation.

2. Installations, procedures and measuring instruments

2.1. Mounting of the steering control

2.1.1. The control shall be mounted on the front section of the vehicle obtained by cutting the body transversely at the level of the front seats, and possibly eliminating the roof, windscreen and doors. This section shall be fixed rigidly to the test bench, so that it does not move under the impact of the body block.

The tolerance on the control mounting angle shall be ± 2 degrees of the design angle.

2.1.2. However, at the request of the manufacturer and with the agreement of the technical service, the steering control may be mounted on a framework simulating the mounting of the steering mechanism, provided that, as compared with the real "front body section/steering mechanism" assembly, the "framework/steering mechanism" assembly has:

2.1.2.1. the same geometrical layout,

2.1.2.2. greater rigidity.

2.2. Setting of the steering mechanism for the tests

2.2.1. During the first test, the steering control shall be turned so that its most rigid spoke is perpendicular to the point of contact with the body block; if the steering control is a steering wheel, the test shall be repeated with the most flexible part of the steering wheel perpendicular to that point of contact. In the case of an adjustable steering control, both tests shall be made with the wheel adjusted to the middle position.

2.2.2. If the vehicle is equipped with a device to adjust the slope and position of the steering wheel, the test shall be performed with the latter in the normal position of use indicated by the manufacturer and regarded by the laboratory as representative from the standpoint of energy absorption.

2.2.3. If the vehicle is equipped with a passive energy absorption system incorporated in the steering wheel, the requirements of paragraph 5.2. of this Regulation shall be met with such system in operation during the test.

2.3. Body block

The body block shall have the shape, dimensions, weight and characteristics shown in the appendix to this annex.

2.4. Measurement of forces

2.4.1. Measurements shall be made of the maximum force, acting horizontally and parallel to the longitudinal axis of the vehicle, applied to the body block as a result of impact against the steering control.

2.4.2. This force may be measured directly or indirectly or may be calculated from values recorded during the test.

2.5. Propulsion of the body block

2.5.1. Any method of propulsion may be used, provided that when the body block strikes the steering control it is free from all connection with the propelling device. The body block shall strike this control after an approximately straight trajectory parallel to the longitudinal axis of the vehicle.

2.5.2. The H point of the body block, indicated by a special mark, shall be so adjusted that before the impact it is in the horizontal plane passing through the R point as indicated by the manufacturer of the vehicle.

2.6. Speed

The body block shall strike the steering control at a speed of 24.1 km/h $\pm \frac{1.2}{0}$ (15 mph $\pm \frac{0.8}{0}$). However, if the test has been carried out at a higher impact speed and the control has met the requirements laid down, the test shall be considered satisfactory.

2.7. Measuring instruments

2.7.1. The instrumentation used to record the parameters referred to in paragraph 5.2 of this Regulation shall enable the measurements to be made with the following accuracy:

2.7.1.1. Speed of body block: within 2 per cent;

2.7.1.2. Time recording: within 1/1000 second

2.7.1.3. The beginning of the impact (zero point) at the moment of first contact of the body block with the steering control shall be identified on the recordings and films used for analysing the results of the test.

2.7.1.4. Measurement of force

The instrumentation used shall conform to the specifications set out in annex 6.

2.7.1.4.1. With load transducers inserted on the steering system:
The channel amplitude class shall be 1,960 daN (2,000 kg) and the channel frequency class 600.

2.7.1.4.2. With accelerometers or load transducers inserted on the body block:
Two unidirectional accelerometers shall be placed symetrically in the transverse plane of the centre of gravity of the body block. The channel amplitude class shall be 60 g and the channel frequency class 180.
Other methods with regard to the number and positioning of the measuring accelerometers shall be allowed, such as by dividing the test apparatus in separate parts at the centre of gravity of which accelerometers are placed to measure the acceleration horizontally and parallel to the longitudinal axis of the vehicle.
The resultant force shall be the force corresponding to the maximum of the sum of forces calculated or measured directly for each part of the body block.

2.8. Ambient temperature: stabilized at 20°C ± 5°C.

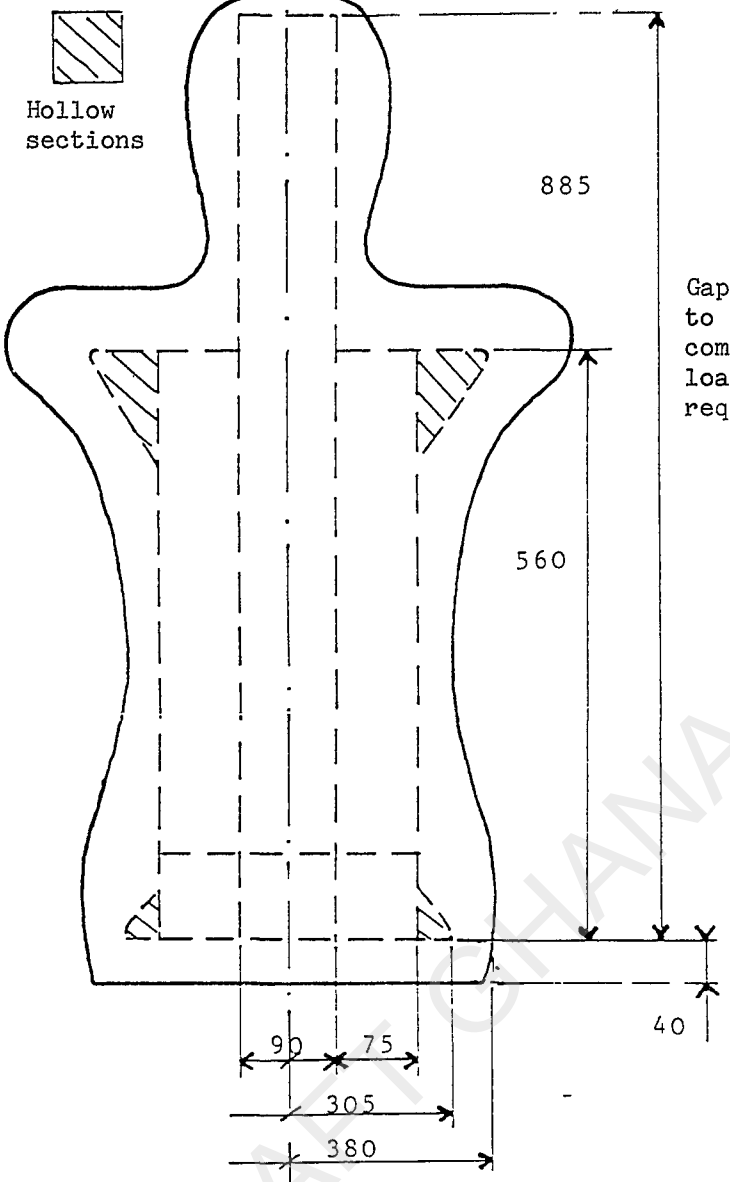
3. Results

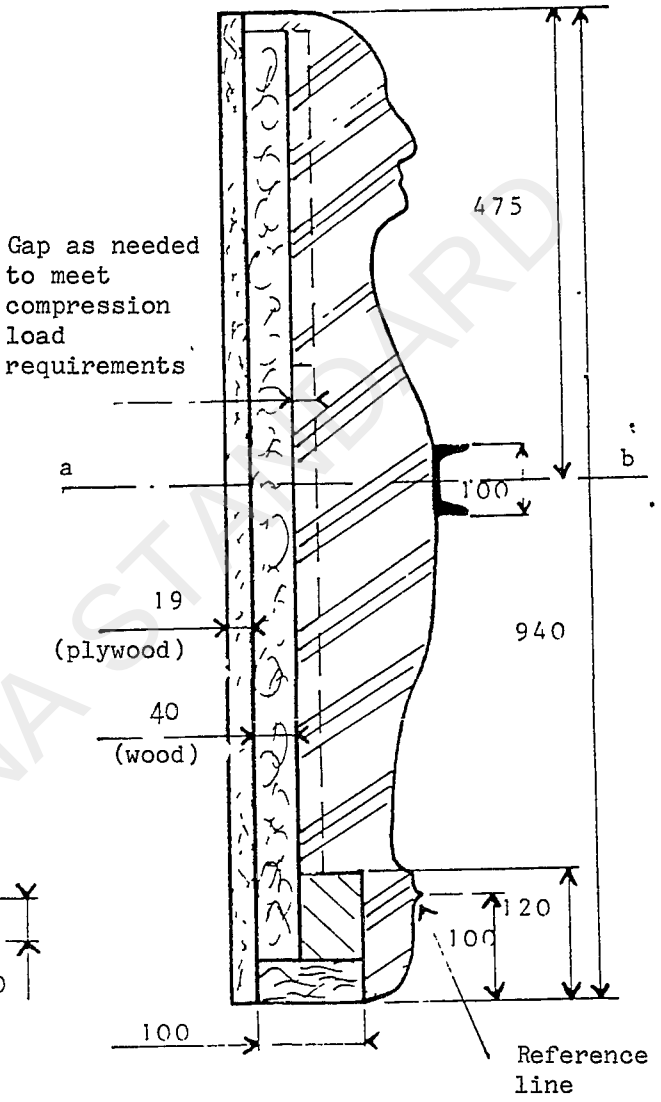
3.1. After the test, the damage sustained by the steering mechanism shall be ascertained and described in a written report; at least one side-view and one front-view photograph of the "steering control/steering column/instrument panel" area shall be taken.

3.2. The maximum value of the force shall be measured or calculated as indicated in paragraph 2.4.

Annex 4 - Appendix
BODY BLOCK

(Mass: 34-36 kg. 50th percentile torso-shaped body block)

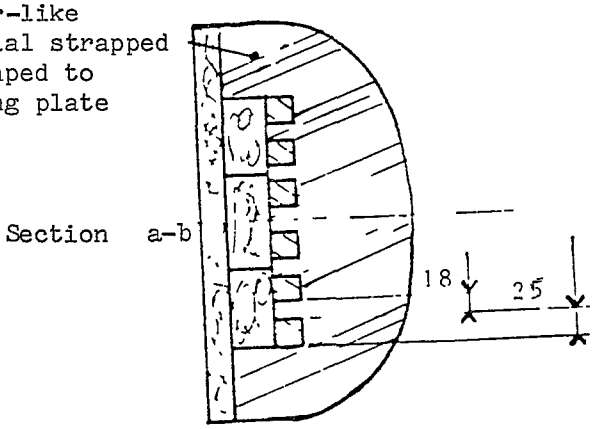




Spring rate: 107 - 143 kgf/cm

The chest is loaded with a 100 mm beam as shown, 90° to the longitudinal axis of the block and parallel to the backing plate. The load is measured when the beam has moved 12.7 mm into the body block.

Rubber-like material strapped and taped to backing plate



Dimensions in mm

Annex 5

TEST PROCEDURE FOR DETERMINING THE ENERGY ABSORPTION CAPACITY OF THE STEERING MECHANISM

1. Installation, test apparatus and procedure

1.1. Installation

1.1.1. The energy-absorbing steering mechanism shall be fitted and tested on the structural support component on which it is installed on the vehicle. It is preferable to carry out the test directly on the vehicle body, whenever possible. The structural component, or the vehicle body, shall be firmly secured to the test bench so as to remain stationary when the impact is applied.

1.1.2. However, at the request of the manufacturer, the mechanism may be mounted on a framework simulating the mounting on the vehicle provided that, as compared with the real "steering mechanism/structural support component" assembly, the "steering mechanism/framework" assembly has the same geometrical layout, at least equal rigidity and an equal or smaller energy-absorbing capacity.

1.2. Test apparatus

1.2.1. This apparatus consists of a pendulum whose pivot is supported by ball-bearings and whose reduced mass[1/] at its centre of percussion is 6.8 kg. The lower extremity of the pendulum consists of a rigid headform 165 mm in diameter whose centre is identical with the centre of percussion of the pendulum.

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

1.3. Setting of the steering mechanism for the test

The steering control shall be set up in the various positions prescribed in paragraph 2.2 of annex 4 to this Regulation.

1/ The relationship of the reduced mass "m_r" of the pendulum to the total mass "m" of the pendulum at a distance "a" between the centre of percussion and the axis of rotation and at a distance "l" between the centre of gravity and the axis of rotation is given by the formula: $m_r = m \frac{l}{a}$.

1.4. Measuring instruments

The measuring instruments used shall conform to the specifications of annex 6. In addition, they shall have the following characteristics:

1.4.1. Acceleration:

Amplitude class 100 g

Frequency class 600

1.4.2. Speed:

accuracy = ± 2.5 per cent of the real value;

sensitivity = 0.5 km/h (0.3 mph).

1.4.3. Time recording:

The instrumentation shall enable the action to be recorded throughout its duration and readings to be made to within one thousandth of a second;

The beginning of the inpact (zero point) shall be the moment of first contact of the headform with the item being tested and shall be identified on the recordings used for analysing the test.

1.5. Test procedure

1.5.1. At any point of impact on the surface to be tested, the direction of impact shall be that defined by the tangent to the trajectory of the headform of the measuring instrument defined in appendix 1.

1.5.2. If the angle between the direction of impact and the perpendicular to the surfacc at the point of impact is 5° or less, the test shall be carried out in such a manner that the tangent to the trajectory of the centre of percussion of the pendulum coincides with the direction of impact. The headform shall strike the test component at a speed of 24.1 km/h ± 1.2 km/h.

1.5.3. If the angle between the direction of impact and the perpendicular to the surface at the point of impact is more than 5°, the test may be carried out in such a manner that the tangent to the trajectory of the centre of percussion of the pendulum coincides with the perpendicular at the point of impact. The value of the test speed shall then be reduced to the value of the normal speed component prescribed in paragraph 1.5.2. above.

2. Results

In tests carried out by the above procedure the deceleration of the headform shall not exceed 80 g continuously for more than 3 milliseconds. The deceleration rate shall be taken as the arithmetic mean of the readings of the two accelerometers.

3. Equivalent procedures

3.1. Equivalent test procedures shall be permitted provided the results required in paragraph 2. above can be obtained.

3.2. Responsibility for demonstrating the equivalence of a method other than that described in paragraph 1. shall rest with the person using such other method.

Annex 5: Appendix 1

DETERMINATION OF THE HEAD-IMPACT ZONE

1. The head-impact zone comprises all the surfaces of the steering mechanism which are capable of entering into static contact with a spherical head 165 mm in diameter that forms part of a measuring apparatus whose dimension from the pivotal point of the hip to the top of the head is continuously adjustable between 736 mm and 840 mm.

2. The aforesaid zone shall be determined by the following procedure or its graphic equivalent:

2.1. The pivotal point of the measuring apparatus shall be placed as follows for the driver's seating position for which the manufacturer has made provision:

2.1.1. In the case of sliding seats:

2.1.1.1. at the R point (see appendix 2), and

2.1.1.2. at a point situated horizontally 127 mm forward of the R point and vertically 19 mm above the R point or at the height resulting from the variation in the height of the R point caused by a forward shift of 127 mm.

2.1.2. In the case of non-sliding seats, at the R point of the seat considered.

2.2. For each value of the dimension from the pivotal point to the top of the head which the test apparatus and the interior dimensions of the vehicle jointly allow, all the points of contact with the steering mechanism shall be determined.

3. A "point of contact" is a point at which the head of the apparatus referred to in paragraph 1 touches a part of the steering mechanism.

Annex 5: Appendix 2

PROCEDURE FOR DETERMINING THE "H" POINT AND THE ACTUAL SEAT-BACK ANGLE AND FOR VERIFYING THEIR RELATIONSHIP TO THE "R" POINT AND THE DESIGN SEAT-BACK ANGLE

1. DEFINITIONS

1.1. The "H" point, which indicates the position of a seated occupant in the passenger compartment, is the trace, in a longitudinal vertical plane, of the theoretical axis of rotation between the legs and the torso of a human body represented by the manikin described in paragraph 3 below.

1.2. The "R" point or "seating reference point" is the reference point specified by the manufacturer which:

1.2.1. has co-ordinates determined in relation to the vehicle structure;

1.2.2. corresponds to the theoretical position of the point of torso/legs rotation ("H" point) for the lowest and most rearward normal driving position or position of use given to each seat provided by the vehicle manufacturer.

1.3. "Seat-back angle" means the inclination of the seat back in relation to the vertical.

1.4. "Actual seat-back angle" means the angle formed by the vertical through the "H" point with the torso reference line of the human body represented by the manikin described in paragraph 3 below.

1.5. "Design seat-back angle" means the angle prescribed by the manufacturer which:

1.5.1. determines the seat-back angle for the lowest and most rearward normal driving position or position of use given to each seat by the vehicle manufacturer;

1.5.2. is formed at the "R" point by the vertical and the torso reference line;

1.5.3. corresponds theoretically to the actual seat-back angle.

2. DETERMINATION OF "H" POINTS AND ACTUAL SEAT-BACK ANGLES

2.1. An "H" point and an "actual seat-back angle" shall be determined for each seat provided by the manufacturer. If the seats in the same row can be regarded as similar (bench seat, identical seats, etc.) only one "H" point and one "actual seat-back angle" shall be determined for each row of seats, the manikin described in paragraph 3 below being seated in a place regarded as representative for the row. This place shall be:

2.1.1. in the case of the front row, the driver's seat;

2.1.2. in the case of the rear row or rows, an outer seat.

2.2. When an "H" point and an "actual seat-back angle" are being determined, the seat considered shall be placed in the lowest and most rearward normal driving position or position of use provided for it by the manufacturer. The seat back shall, if its inclination is adjustable, be locked as specified by the manufacturer or, in the absence of any specification, to an actual seat-back angle as near as possible to 25° from the vertical.

3. DESCRIPTION OF THE MANIKIN

3.1. A three-dimensional manikin of a mass and contour corresponding to those of an adult male of average height shall be used. Such a manikin is depicted in figures 1 and 2 below.

3.2. The manikin shall comprise:

3.2.1. Two components, one simulating the back and the other the seat of the body, pivoting on an axis representing the axis of rotation between the torso and the thigh; the trace of this axis on the side of the manikin is the manikin's "H" point;

3.2.2. Two components simulating the legs and pivotally attached to the component simulating the seat; and

3.2.3. Two components simulating the feet and connected to the legs by pivotal joints simulating ankles.

3.2.4. In addition, the component simulating the seat of the body shall be provided with a level enabling its transverse orientation to be verified.

3.3. Body-segment mass shall be attached at appropriate points representing the corresponding centres of gravity so as to bring the total mass of the manikin up to about 75.6 kg. Details of the various weights are given in the table in figure 2 of this annex.

3.4. The torso reference line of the manikin is taken into account by a straight line passing through the joint between the leg and the pelvis and the theoretical joint between the neck and the thorax (see figure 1).

4. SETTING UP THE MANIKIN

The three-dimensional manikin shall be set up in the following manner:

4.1. The vehicle shall be placed on a horizontal plane and the seats adjusted as prescribed in paragraph 2.2. above;

4.2. The seat to be tested shall be covered with a piece of cloth to facilitate the correct setting-up of the manikin;

4.3. The manikin shall be placed on the seat concerned, its pivotal axis being perpendicular to the longitudinal plane of symmetry of the vehicle;

4.4. The feet of the manikin shall be placed as follows:

4.4.1. In the front seats, in such a way that the level verifying the transverse orientation of the seat of the manikin is brought to the horizontal;

4.4.2. In the rear seats, so far as possible in such a way as to be in contact with the front seats. If the feet then rest on parts of the floor which are at different levels, the foot which first comes into contact with the front seat shall serve as a reference point and the other foot shall be so arranged that the level enabling the transverse orientation of the seat of the manikin to be verified is brought to the horizontal;

4.4.3. If the "H" point is being determined at a centre seat, the feet shall be placed one on each side of the tunnel;

4.5. The weights shall be placed on the thighs, the level verifying the transverse orientation of the seat of the manikin shall be brought to the horizontal, and the weights shall be placed on the component representing the seat of the manikin;

4.6. The manikin shall be moved away from the seat back by means of the knee-pivot bar and the back of the manikin shall be pivoted forwards. The manikin shall be repositioned on the seat of the vehicle by being slid backwards on its seat until resistance is encountered, the back of the manikin then being replaced against the seat back;

4.7. A horizontal load of approximately 10 $\pm$ 1 daN shall be applied to the manikin twice. The direction and point of application of the load are shown by a black arrow in figure 2;

4.8. The weights shall be installed on the right and left sides and the torso weights shall then be placed in position. The transverse level of the manikin shall be kept horizontal;

4.9. The transverse level of the manikin being kept horizontal, the back of the manikin shall be pivoted forwards until the torso weights are above the "H" point, so as to eliminate any friction with the seat back;

4.10. The back of the manikin shall be gently moved rearwards so as to complete the setting-up operation. The transverse level of the manikin shall be horizontal. If it is not, the procedure described above shall be repeated.

5. RESULTS

5.1. When the manikin has been set up as described in paragraph 4 above, the "H" point and the actual seat-back angle of the vehicle seat in question are constituted by the "H" point and the angle of inclination of the manikin's torso reference line.

5.2. The co-ordinates of the "H" point in relation to three mutually perpendicular planes, and the actual seat-back angle, shall be measured for comparison with the data supplied by the vehicle manufacturer.

6. VERIFYING THE RELATIVE POSITIONS OF THE "R" AND "H" POINTS AND THE RELATIONSHIP BETWEEN THE DESIGN SEAT-BACK ANGLE AND THE ACTUAL SEAT-BACK ANGLE

6.1. The results of the measurements carried out in conformity with paragraph 5.2. for the "H" point and the actual seat-back angle shall be compared with the co-ordinates of the "R" point and the design seat-back angle as supplied by the vehicle manufacturer.

6.2. The relative positions of the "R" point and the "H" point and the relationship between the design seat-back angle and the actual seat-back angle shall be considered satisfactory for the seat in question if the "H" point, as defined by its co-ordinates, lies within a square of 50 mm side whose diagonals intersect at the "R" point, and if the actual seat-back angle is within 5° of the design seat-back angle.

6.2.1. If these conditions are met, the "R" point and the design seat-back angle shall be used for the test and, if necessary, the manikin shall be so adjusted that the "H" point coincides with the "R" point and the actual seat-back angle coincides with the design seat-back angle.

6.3. If the "H" point or the actual seat-back angle does not satisfy the requirements of paragraph 6.2. above, the "H" point or the actual seat-back angle shall be determined twice more (three times in all). If the results of two of these three operations satisfy the requirements, the result of the test shall be considered satisfactory.

6.4. Unless at least two of the three test results satisfy the requirements of paragraph 6.2., the result of the test shall be considered to be not satisfactory.

6.5. If the situation described in paragraph 6.4. above arises, or if verification cannot be effected because the manufacturer has failed to supply information regarding the position of the "R" point or regarding the design seat-back angle, the average of the results of the three determinations may be used and be regarded as applicable in all cases where the "R" point or the design seat-back angle is referred to in this Regulation.

Annex 5: Appendix 3

COMPONENTS OF THREE-DIMENSIONAL MANIKIN

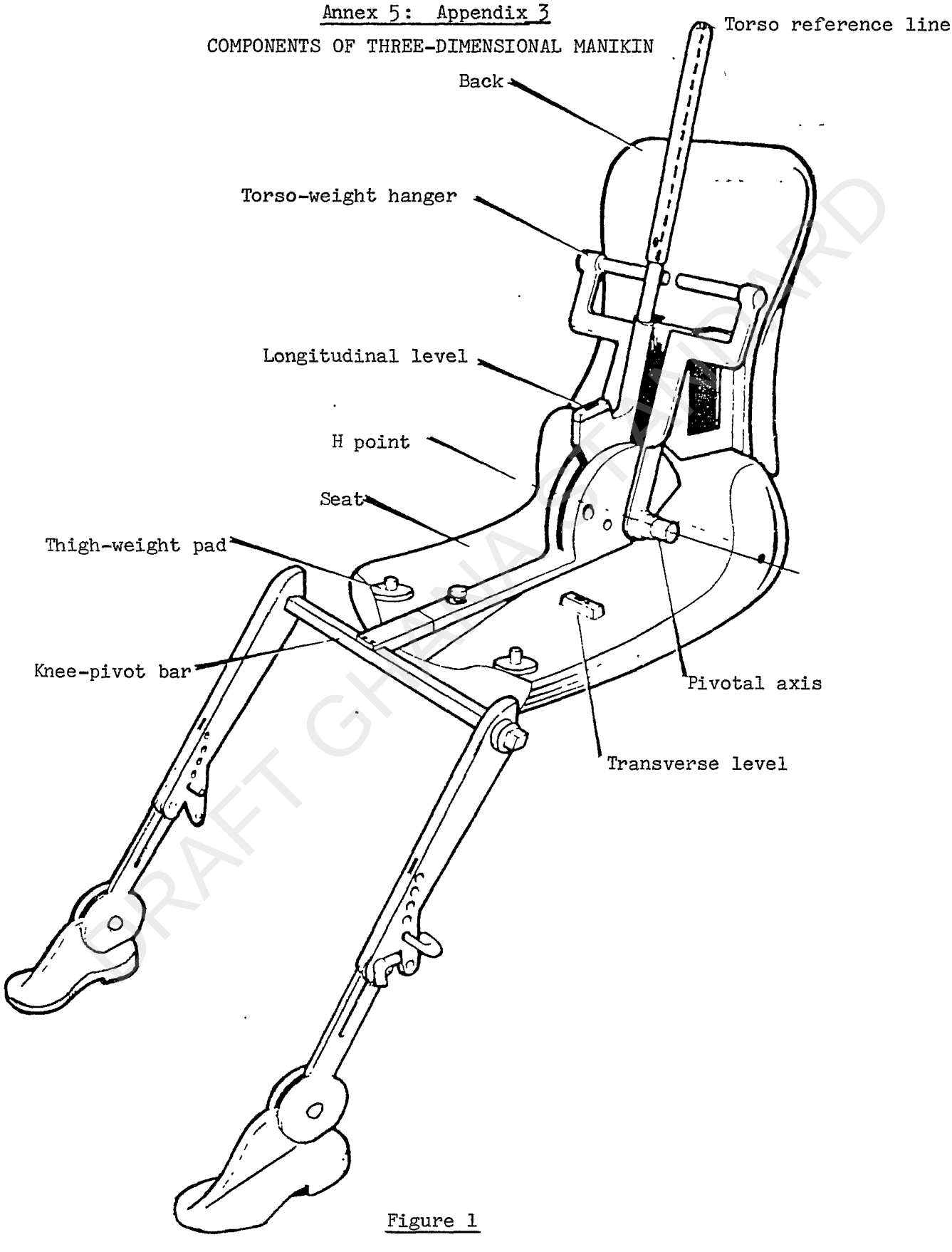


Figure 1

DIMENSIONS AND MASS OF MANIKIN

Mass of manikin

Components simulating back and seat of body	kg 16.6
Torso weights	31.2
Seat weights	7.8
Thigh weights	6.8
Leg weights	13.2
Total:	75.6

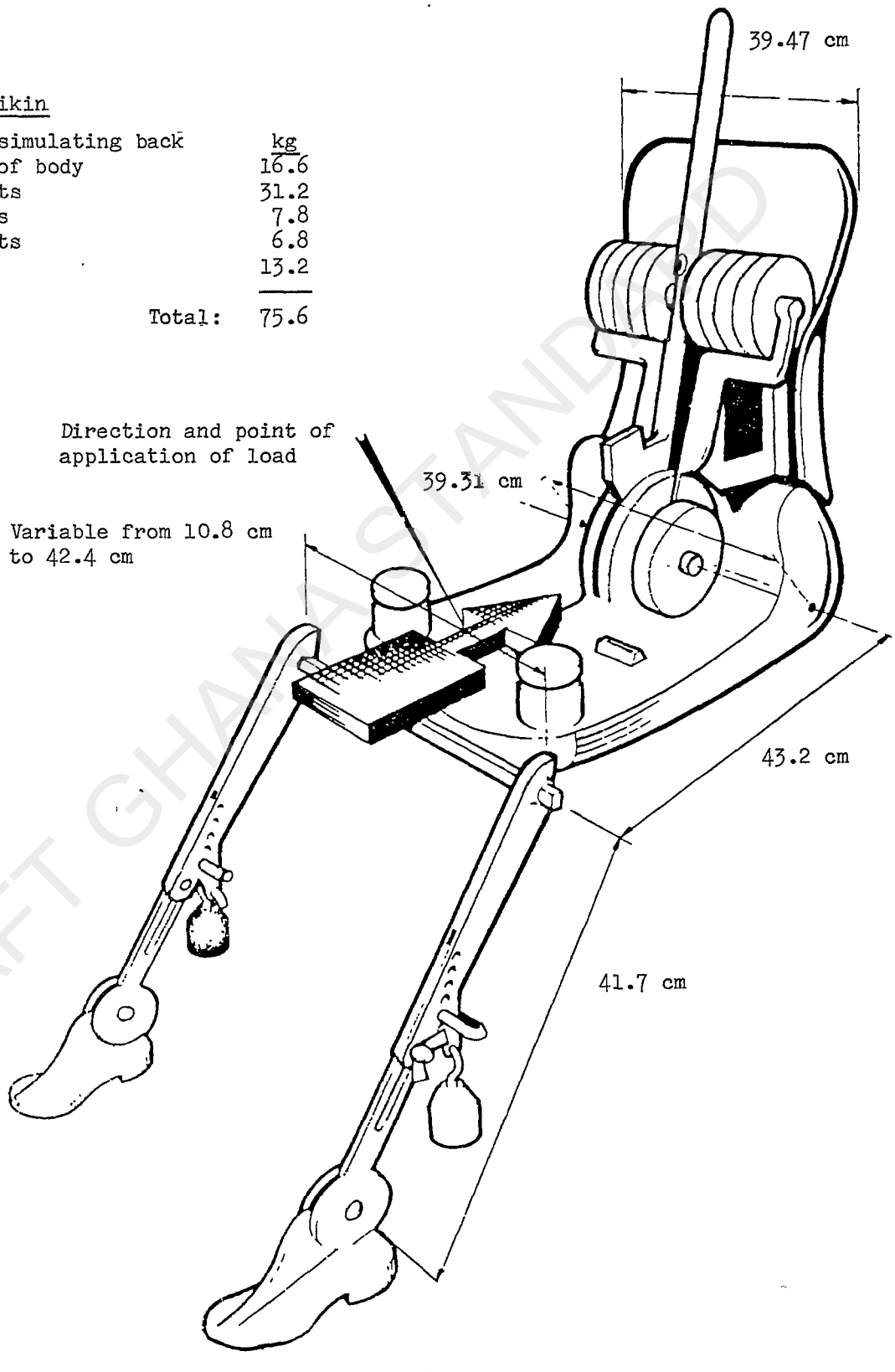


Figure 2

Annex 6

TECHNIQUE OF MEASUREMENT IN TESTS

1. DEFINITIONS

1.1. Data channel

All the instrumentation from a transducer (or multiple transducers whose outputs are combined in some specified way) up to and including any analysis procedures that may alter the frequency content or the amplitude content of data.

1.2. Transducer

The first device in a data channel used to convert a physical quantity to be measured into a second quantity (such as an electrical voltage) which can be processed by the remainder of the channel.

1.3. Channel amplitude class: CAC

The designation for a data channel that meets certain amplitude characteristics as specified in this annex. The CAC number is numerically equal to the upper limit of the measurement range.

1.4. Characteristic frequencies F_H, F_L, F_N

These frequencies are defined in figure 1.

1.5. Channel frequency class: CFC

The channel frequency class is designated by a number indicating that the channel frequency response lies within the limits specified in figure 1. This number and the value of the frequency F_H in Hz are numerically equal.

1.6 Sensitivity coefficient

The slope of the straight line representing the best fit to the calibration values determined by the method of least squares within the channel amplitude class.

1.7. Calibration factor of a data channel

The mean value of the sensitivity coefficients evaluated over frequencies which are evenly spaced on a logarithmic scale between F_L and $\frac{F_H}{2.5}$.

1.8. Linearity error

The ratio, in per cent, of the maximum difference between the calibration value and the corresponding value read on the straight line defined in paragraph 1.6 at the upper limit of the channel amplitude class.

1.9 Cross sensitivity

The ratio of the output signal to the input signal, when an excitation is applied to the transducer perpendicular to the measurement axis. It is expressed as a percentage of the sensitivity along the measurement axis.

1.10. Phase delay time

The phase delay time of a data channel is equal to the phase delay (in radians) of a sinuscidal signal, divided by the angular frequency of that signal (in radians/second).

1.11. Environment

The aggregate, at a given moment, of all external conditions and influences to which the data channel is subjected.

2. PERFORMANCE REQUIREMENTS

2.1 Linearity error

The absolute value of the linearity error of a data channel at any frequency in the CFC, shall be equal to or less than 2.5 per cent of the value of the CAC, over the whole measurement range.

2.2 Amplitude against frequency 1/

The frequency response of a data channel shall lie within the limiting curves given in figure 1. The zero dB line is determined by the calibration factor.

2.3. Phase delay time 1/

The phase delay time between the input and the output signals of a data channel shall be determined and shall not vary by more than $\frac{1}{10\ F_H}$ s between $0.03\ F_H$ and F_H.

2.4. Time

2.4.1. Time base

A time base shall be recorded and shall at least give 1/100s with an accuracy of 1 per cent.

1/ No method for the evaluation of the dynamic response during calibration of data channels for forces and displacements is included in this annex because no satisfactory method is yet known.

2.4.2. Relative time delay

The relative time delay between the signals of two or more data channels, regardless of their frequency class, must not exceed 1 ms excluding delay caused by phase shift.

Two or more data channels of which the signals are combined shall have the same frequency class and shall not have a relative time delay greater than $\frac{1}{10 F_H}$ s.

This requirement applies to analogue signals as well as to synchronization pulses and digital signals.

2.5. Transducer cross sensitivity

The transducer cross sensitivity shall be less than 5 per cent in any direction.

2.6. Calibration

2.6.1. General

A data channel shall be calibrated at least once a year against reference equipment traceable to known standards. The methods used to carry out a comparison with reference equipment shall not introduce an error greater than 1 per cent of the CAC. The use of the reference equipment is limited to the frequency range for which they have been calibrated. Subsystems of a data channel may be evaluated individually and the results factored into the accuracy of the total data channel. This can be done for example by an electrical signal of known amplitude simulating the output signal of the transducer which allows a check to be made on the gain factor of the data channel, excluding the transducer.

2.6.2. Accuracy of reference equipment for calibration

The accuracy of the reference equipment shall be certified or endorsed by an official metrology service.

2.6.2.1. Static calibration

2.6.2.1.1. Accelerations

The error shall be less than ± 1.5 per cent of the channel amplitude class.

2.6.2.1.2. Forces

The error shall be less than ± 1 per cent of the channel amplitude class.

2.6.2.1.3. Displacements

The error shall be less than ± 1 per cent of the channel amplitude class.

2.6.2.2. Dynamic calibration

2.6.2.2.1. Accelerations

The error in the reference accelerations expressed as a percentage of the channel amplitude class shall be less than ± 1.5 per cent below 400 Hz, less than ± 2 per cent between 400 Hz and 900 Hz, and less than ± 2.5 per cent above 900 Hz.

2.6.2.2.2. Forces and displacements 2/

See foot-note.

2.6.2.3. Time

The relative error in the reference time shall be less than 10^{-5}.

2.6.3. Sensitivity coefficient and linearity error

The sensitivity coefficient and the linearity error shall be determined by measuring the output signal of the data channel against a known input signal, for various values of this signal.

The calibration of the data channel shall cover the whole range of the amplitude class.

For bi-directional channels, both the positive and negative values shall be used.

If the calibration equipment cannot produce the required input, owing to the excessively high values of the quantity to be measured, calibrations shall be carried out within the limits of the calibration standards and these limits shall be recorded in the test report.

A total data channel shall be calibrated at a frequency or at a spectrum of frequencies having a significant value between F_L and $\frac{F_H}{2.5}$.

2.6.4. Calibration of the frequency response

The response curves of phase and amplitude against frequency shall be determined by measuring the output signals of the data channel in terms of phase and amplitude against a known input signal, for various values of this signal varying between F_L and 10 times the CFC or 3000 Hz, whichever is lower.

2.7 Environmental effects

A regular check shall be made to identify any environmental influence (such as electric or magnetic flux, cable velocity etc.).

This can be done for instance by recording the output of spare channels equipped with dummy transducers.

If significant output signals are obtained corrective action shall be taken, for instance by replacement of cables.

2/ No method for the evaluation of the dynamic response during calibration of data channels for forces and displacements is included in this annex because no satisfactory method is yet known.

2.8. Choice and designation of the data channel

The CAC and CFC define a data channel. 3/

The CAC shall be 1, 2 or 5 to a power of ten.

A data channel conforming to the specifications of this annex shall be designated according to the following code:

ISO ... (number of the standard)

CAC ... (channel amplitude class)

CFC ... (channel frequency class)

If the calibration of the amplitude response does not cover the complete CAC owing to limited properties of the calibration equipment, the CAC shall be marked with an asterisk.

Example: ISO ...
CAC* 200 m/s^2
CFC 1000 Hz

means that:

The measurement has been carried out according to this annex;

The channel amplitude class was 200 m/s^2;

The channel frequency class was 1000 Hz;

Calibration of the amplitude response did not cover the complete CAC.

The test report shall indicate the calibration limits.

3. MOUNTING OF TRANSDUCERS

Transducers should be rigidly secured so that their recordings are affected by vibration as little as possible. Any mounting having a lowest resonance frequency equal to at least 5 times the frequency F_H of the data channel considered shall be considered valid.

Acceleration transducers in particular should be mounted in such a way that the initial angle of the real measurement axis to the corresponding axis of the reference axis system is not greater than 5° unless an analytical or experimental assessment of the effect of the mounting on the collected data is made. When multi-axial accelerations at a point are to be measured, each acceleration transducer axis should pass within 10 mm of that point, and the centre of seismic mass of each accelerometer should be within 30 mm of that point.

3/ Their values being chosen for a given application by the body requiring this application.

4. RECORDING

4.1. Analogue magnetic recorder

Tape speed should be stable to within not more than 0.5 per cent of the tape speed used. The signal-to-noise ratio of the recorder should not be less than 42 dB at the maximum tape speed.

The total harmonic distortion should be less than 3 per cent and the linearity error should be less than 1 per cent of the measurement range.

4.2. Digital magnetic recorder

Tape speed should be stable to within not more than 10 per cent of the tape speed used.

4.3. Paper tape recorder

In case of direct data recording the paper speed in mm/s should be at least 1.5 times the number expressing F_H in Hz.

In other cases the paper speed should be such that equivalent resolution is obtained.

5. DATA PROCESSING

5.1. Filtering

Filtering corresponding to the frequencies of the data channel class may be carried out during either recording or processing of data. However, before recording, analogical filtering at a higher level than CFC should be effected in order to use at least 50 per cent of the dynamic range of the recorder and to reduce the risk of high frequencies saturating the recorder or causing aliasing errors in the digitizing process.

5.2. Digitizing

5.2.1. Sampling frequency

The sampling frequency should be equal to at least 8 F_H.

In the case of analogical recording, when the recording and reading speed are different, the sampling frequency can be divided by the speed ratio.

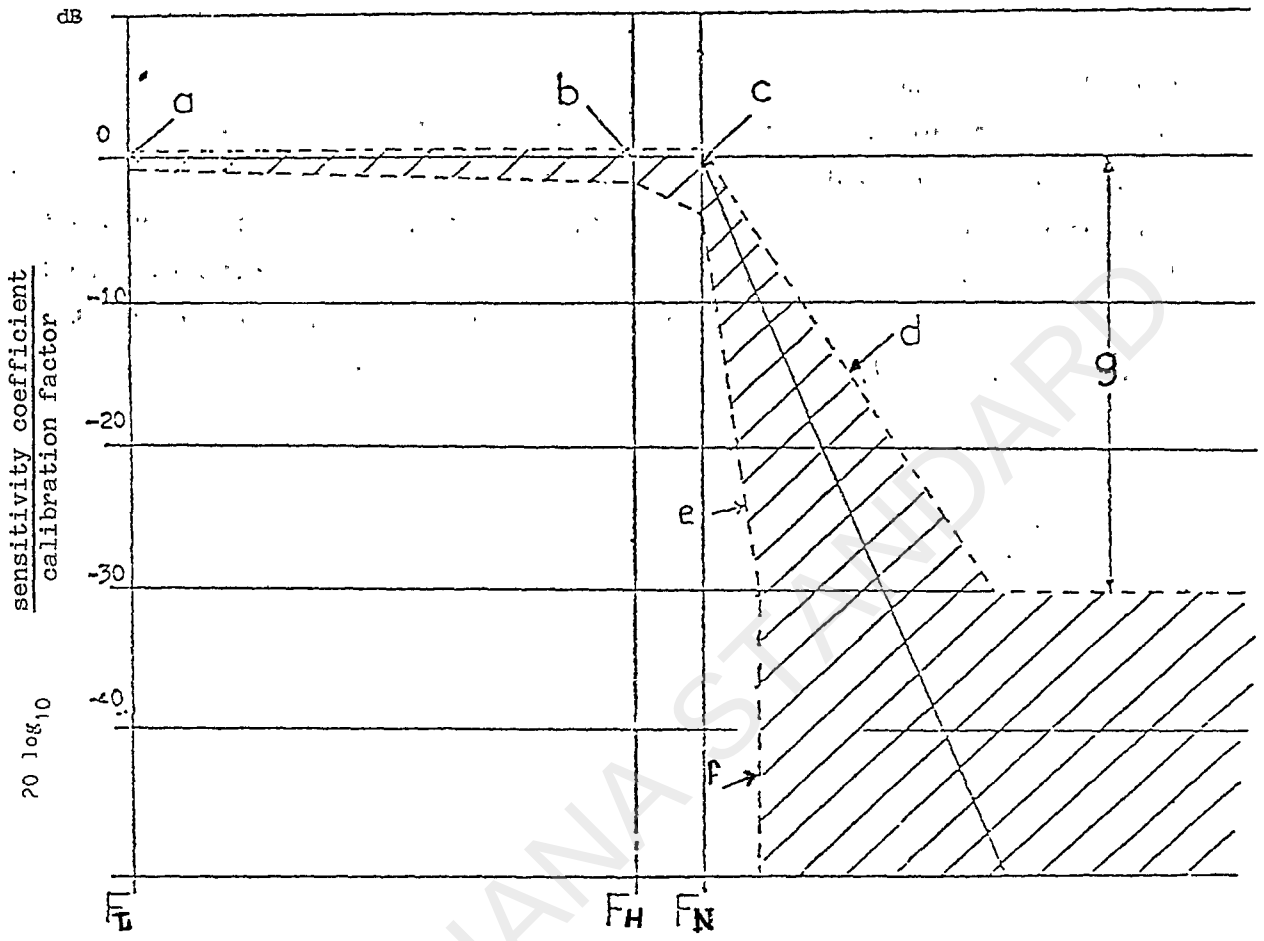
5.2.2. Amplitude resolution

The length of digital words should be at least 7 bits and a sign.

6. PRESENTATION OF RESULTS

The results should be presented on A4 size paper (ISO/R 216).

Results presented as diagrams should have axes scaled with a measurement unit corresponding to a suitable multiple of the chosen unit (for example, 1, 2, 5, 10, 20 millimetres). SI units shall be used, except for vehicle velocity, where km/h may be used, and for accelerations due to impact where g, with g = 9.81 m/s^2, may be used.



CFC	F_L Hz	F_H Hz	F_N Hz
1 000	0.1	1 000	1 650
600	0.1	600	1 000
180	0.1	180	300
60	0.1	60	100

a	±	0.5 dB
b	+	0.5; - 1 dB
c	+	0.5; - 4 dB
d	-	9 dB/octave
e	-	24 dB/octave
f	-	00 dB/octave
g	-	30 dB

Figure 1
FREQUENCY RESPONSE CURVE