

**AUTOMOTIVE INDUSTRY STANDARD**

**Requirements for Behavior of  
Steering Mechanism of a Vehicle  
in a Head-on Collision**

PRINTED BY  
THE AUTOMOTIVE RESEARCH ASSOCIATION OF INDIA  
P.B. NO. 832, PUNE 411 004

ON BEHALF OF  
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER  
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

SET-UP BY  
MINISTRY OF SHIPPING, ROAD TRANSPORT & HIGHWAYS  
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)  
GOVERNMENT OF INDIA

August 2008

**Status chart of the standard to be used by the purchaser for updating the record**

<b>Sr. No.</b>	<b>Corr-igenda.</b>	<b>Amend-ment</b>	<b>Revision</b>	<b>Date</b>	<b>Remark</b>	<b>Misc.</b>
General remarks :						

## INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the erstwhile Ministry of Surface Transport (MoST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India, (ARAI), Pune, being the secretariat of the AIS Committee, has published this standard.

Based on deliberations in the CMVR-TSC and AISC it has been decided to create a suite of standards related to Passive Safety which are founded on dynamic (or crash) testing of passenger cars and utility vehicles. These standards would then form the basis of the notification and implementation of advanced passive safety norms in the latter part of this decade as per the Safety Road Map adopted for India.

The first standard being addressed in this series of work is the full frontal crash standard for M1 Category vehicles. Accordingly, the existing national standard IS 11939:1996 is being revised and aligned with current European practice wherein the standard is applicable in part to all M1 category vehicles and in part to M1 category vehicles in the 2500kg to 3500kg gross vehicle mass range.

While preparing this standard considerable assistance is derived from following international standards:

ECE R12 ( Supp. 3 to 03 series of Amd.)	Uniform provisions concerning the approval of vehicles with regard to the protection of the driver against the steering mechanism in the event of impact
EEC Directive 74/297/EEC (last amended by 91/662/EEC)	Interior fittings of motor vehicles (the behaviour of the steering mechanism in the event of an impact)

The Automotive Industry Standards Committee responsible for preparation of this standard is given in Annex : 4

## Requirements for Behavior of Steering Mechanism of a Vehicle in a Head-on Collision

### 0. SCOPE

- 0.1 This standard applies to the behavior of the steering mechanism of vehicles of category N1 with maximum mass less than 1500kg and of vehicles of category M1.
- 0.2 However vehicles of category M1 with maximum mass not exceeding 2500kg are exempt from the requirements of paragraph 5.1 of this standard.
- 0.3 This standard shall not apply to multi-stage built vehicles produced in quantities not exceeding 500 vehicles in any period of 12 months duration.

### 1 REFERENCES

- 1.1 EEC Directive 70/156/EEC      On the approximation of the laws of the Member States relating to the Type Approval of Motor Vehicles and their Trailers
- 1.2 AIS-097                Procedure for Determining the "H" Point and the Torso Angle for 50<sup>th</sup> Percentile Adult Male in Seating Positions of Motor Vehicles
- 1.3 ISO:6487-1987      Road Vehicles – Measurement Techniques in Impact Tests – Instrumentation
- 1.4 AIS-098                Requirements for the Protection of the Occupants in the event of an Offset Frontal Collision
- 1.5 IS:11939 1996      Automotive Vehicles – Steering Control Systems – Impact Protection Requirements and Methods of Measurement (First Revision).

### 2. DEFINITIONS

For the purposes of this standard,

- 2.1 **'Behaviour of the steering mechanism in the event of an impact'** means the behaviour of this mechanism under the effect of three types of forces, i.e.:
  - 2.1.1 those resulting from a frontal collision which may produce displacement of the steering column towards the rear;
  - 2.1.2 those due to the driver's head inertia in the event of an impact against the steering control in a frontal collision;
  - 2.1.3 those due to the driver's body inertia in event of an impact against the steering control in a frontal collision;

- 2.2 **"Approval of a vehicle"** means the approval of a vehicle type with regard to:
  - 2.2.1 the protection of the driver against the steering mechanism in the event of impact;
- 2.3 **"Vehicle type"** means a category of motor vehicles which do not differ in such essential respects as;
  - 2.3.1 Vehicle powered by an internal combustion engine,
    - 2.3.1.1 the structure, dimensions, lines & constituent materials of that part of the vehicle forward of the steering control,
    - 2.3.1.2 the mass of vehicle in running order, as defined in paragraph 2.19 below;
  - 2.3.2 vehicle powered by an electric motor,
    - 2.3.2.1. dimensions, mass, structure of the vehicle, forms & constituent materials, place of the components of the propulsion system, place of the battery or of the parts of the propulsion battery,
  - 2.3.3 mass of the vehicle in running order as defined in 2.19 below.
- 2.4 **"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;
- 2.5 **"Steering control type"** means a category of steering controls which do not differ in such essential respects as:
  - 2.5.1 the structure, dimensions, lines and constituent materials;
- 2.6 **"Steering control"** means the steering device, usually the steering wheel, which is actuated by the driver;
- 2.7 **"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;
- 2.8 **"Air-bag"** means a flexible bag that is designed to be filled with a gas under pressure, and is:
  - 2.8.1 designed to protect the vehicle driver in an impact against the steering control;
  - 2.8.2 inflated by a device which is actuated in case of vehicle's impact;
- 2.9 **"Steering control rim"** means the quasi-toroidal outer ring in the case of the steering wheel usually gripped by the driver's hands during driving;
- 2.10 **"Spoke"** means a bar connecting the steering control rim to the boss
- 2.11 **"Boss"** means that part of the steering control, usually at the centre, that:

- 2.11.1 joins the steering control to the steering shaft,
- 2.11.2 transmits the torque from the steering control to the steering shaft;
- 2.12 **“Center of the steering control boss”** means that point on the surface of the boss which is in line with the axis of the steering shaft;
- 2.13 **“Plane of the steering control”** means in the case of the steering wheel the flat surface that splits the steering wheel rim equally between the driver and the front of the vehicle;
- 2.14 **“Steering shaft”** means the component which transmits to the steering gear the torque applied to the steering control;
- 2.15 **“Steering column”** means the housing enclosing the steering shaft;
- 2.16 **“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;
- 2.17 **“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, and if necessary any partition of the tray(s) containing the monoblocs of the electric vehicle’s propulsion battery,
- 2.18 **“Impactor”** consists of a rigid hemispherical headform 165 mm in diameter, in accordance with Annex 3, paragraph 3 of this standard;
- 2.19 **“Mass of the vehicle in running order”** means the mass of the vehicle unoccupied and unladen but complete with fuel, coolant, lubricant tools and spare wheel (if provided as standard equipment by the vehicle manufacturer) & propulsion battery tray(s) including the monoblocs of the electric vehicle’s propulsion battery.
- 2.20 **“Vehicle's reference plane”** is a plane related to the vehicle and horizontal when the vehicle in the state defined in paragraph 2.19 above rests on a horizontal plane.
- 2.21 **“Forward control”** is a driving cab configuration in which more than half of the engine length is rearward of the foremost point of the windshield base and the steering wheel hub in the forward quarter of the vehicle length. (Refer EEC Directive : 70/156/EEC, Annex 1, paragraph 1.7, Note z).
- 2.22 **“R point”** or **“seating reference point”** means a seating reference point as defined in paragraph 2.4 of AIS-097
- 2.23 **“Monobloc”** means the smallest unit of the electric energy source.
- 2.24 **“Propulsion battery”** means the assembly of the blocs constituting the electric energy source.

- 2.25 **“Propulsion battery tray”** means the tray containing one or more monoblocs; a vehicle can comprise no tray or one or more trays.
- 2.26 (Reserved)
- 2.27 (Reserved)
- 2.28 (Reserved)
- 2.29 (Reserved)
- 2.30 (Reserved)
- 2.31 **“Multistage type approval”** means procedure whereby one or more testing agencies certify that depending on the state of completion, an incomplete or completed vehicle type satisfies the relevant technical requirements of the standard.
- 2.32 **‘Multi-stage build’** means the procedure whereby two or more manufacturers separately and sequentially participate in the construction of a vehicle.

### **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 under mentioned 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 mass of the vehicle in running order;
- 3.1.3 The following shall be submitted to the testing agency 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 testing agency, either a second vehicle, or those parts of the vehicle regarded by him as essential for the test referred to in paragraphs 5.2 and 5.3 below.

- 3.1.3.3 the testing agency shall verify the existence of satisfactory arrangements for ensuring effective control of the conformity of production before type approval is granted.

## **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 impact shall be submitted by the steering control manufacturer or by his duly accredited representative.
- 3.2.2 It shall be accompanied by the under mentioned 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.
  - 3.2.3 A steering control representative of the steering control type to be approved plus, at the manufacturer's discretion, with the agreement of the testing agency, those parts of the vehicle regarded by him as essential for the test, shall be submitted to the testing agency responsible for conducting approval tests for the test referred to in paragraphs 5.2 and 5.3 below.

## **4. APPROVAL**

### **4.1 Vehicle Type**

If the vehicle submitted for approval pursuant to this standard meets the requirements of paragraphs 5 and 6 below and Annexes 1, 2 and 3 to this standard, approval of that vehicle type shall be granted.

### **4.2 Steering Control Type**

If the steering control submitted for separate approval pursuant to this standard meets the applicable requirements of paragraphs 5 and 6 below and Annexes 1, 2 and 3 to this standard, approval of that steering control type shall be granted. This is only applicable to steering controls, which do not include an airbag.

## **5. SPECIFICATIONS**

- 5.1 When the vehicle in running order, without a manikin is collision tested against a barrier at a speed of 48.3 km /hr as per Annex 1
  - 5.1.1 During the test, the top of the steering and its shaft shall not move backwards by more than 127mm and upwards by more than 127mm when measured as per paragraph 3.1 of Annex 1 and corrected as per paragraph 4.2 of Annex 1.



A vehicle which has been certified as complying to paragraph 5.2.2 the offset frontal collision test requirements of AIS-098 shall be deemed to have met the requirements of 5.1.1

- 5.1.2 in the cases of vehicle powered by an electric motor, the impact test prescribed in paragraph 5.1 shall be carried out with the propulsion battery master switch in the “ON” position. In addition, the following requirements shall be satisfied during and after the test.
  - 5.1.2.1. The monoblocs shall remain fixed in their places,
  - 5.1.2.2. no liquid electrolyte shall leak into the passenger compartment, a limited leakage is permissible, however, only to outside the vehicle, provided that the leakage which occurs during the first hour after the test does not exceed 7% of the total of the liquid electrolyte in the propulsion battery.
- 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.
- 5.2.1 If the steering control is fitted with a steering wheel airbag, specifications of paragraph 5.2 above are deemed to be met if the vehicle equipped with such a steering system complies with the specifications of paragraphs 5.2.1.4 and 5.2.1.5 of AIS-098.
- 5.3 When the steering control is struck by an impactor released against this control at a relative speed of 24.1 km/h, in accordance with the procedures of Annex 3, the deceleration of the impactor shall not exceed 80 g cumulative for more than 3 milliseconds. The deceleration shall always be lower than 120 g with Channel Frequency Class 600 Hz of ISO 6487-1987.
- 5.4 The steering control shall be designed, constructed and fitted in such a way that:
  - 5.4.1 Before the impact tests prescribed in paragraphs 5.2 and 5.3 above no part of the steering control surface, directed towards the driver, which can be contacted by a sphere of 165mm in diameter shall present any roughness or sharp edges with a radius of curvature of less than 2.5mm.
    - 5.4.1.1 After any impact tests prescribed in paragraphs 5.2 and 5.3 the part of the steering control surface directed towards the driver shall not present any sharp or rough edges likely to increase the danger of severity of injuries to the driver. Small surface cracks and fissures shall be disregarded.
      - 5.4.1.1.1 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 5.4.1.1 shall only apply to the rigid support.
  - 5.4.2 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.

- 5.4.3 In the case of steering controls not intended to form part of the original equipment they shall be required to meet the specification when tested in accordance with Annex 2, paragraph 2.1.3. and Annex 3, paragraph 2.3.
- 5.4.4 In the case of "general steering controls", the requirements shall be met over:
  - 5.4.4.1 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;
  - 5.4.4.2 the full range of possible impactor and 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.
- 5.4.5 Where adaptors are used to adapt a single type of steering control to a range of steering columns, 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 1, 2 and 3 to this standard. All measurements should be done on the basis of ISO 6487-1987.
- 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. CRITERIA FOR EXTENSION OF APPROVAL**

- 7.1 The approval accorded under this standard to a vehicle may be extended to:
  - 7.1.1 A variant whose mass in running order is same as or less than the mass in running order of the vehicle.
  - 7.1.2 A variant whose mass in running order is more than the mass in order of the vehicle subjected to the defined approval test but less than the actual test mass (defined as  $m_1$  in paragraph 4.1 of Annex 1) of the vehicle subjected to the approval test.
  - 7.1.3 For the purposes of paragraphs 7.1.1 and 7.1.2 variant shall be considered to be that vehicle whose layout of parts ahead of the bulkhead (firewall) and of the steering system is similar to but not more adverse (for the intents of this standard) than the vehicle subjected to the approval test.

- 7.1.4 In the case of reduction in the mass of the steering wheel, tests as per paragraph 5.1 (crash test) and 5.2 (body block impact test) are not required for proving compliance to this standard,
- 7.1.5 In the case of reduction in the inclination of the steering column axis with respect to horizontal plane, test as per paragraph 5.2 (bodyblock impact test) is not required for proving compliance to this standard,
- 7.1.6 In the case of change in steering column inclination, test as per paragraph 5.3 (headform impact test) is not required for proving compliance to this standard,
- 7.1.7 In the case of increase in the height of the seat R point from the floor, no test is required to prove the compliance with this standard,
- 7.2 An approval accorded to veh type may be extended to another version of same type where the difference of mass is within the criterion specified in para 4.3 of Annex 1.
- 7.3 The approval accorded to a vehicle of category M1 may be extended to a vehicle of category N1 whose design/construction has been derived from approved M1 vehicle and which has substantially similar characteristics.
- 7.4 The approval accorded to vehicles which comply with IS:11939 (1996) can be extended to the requirements of this standard.

**ANNEX 1**

(See 4.1)

**FRONTAL - IMPACT TEST AGAINST A BARRIER****1. PURPOSE**

The purpose of this test is to verify whether the vehicle satisfies the requirements set forth in paragraph 5.1

**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% 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  $19 \pm 1$  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  $\pm 30$  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 mass 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 mass 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 standard, 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 mass 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% 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% full. All other reservoirs shall be filled to capacity.

If the manufacturer so desires and the testing agency 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% 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 testing agency responsible for conducting the tests may allow the same vehicle as is used for tests prescribed by other standards (including tests capable of affecting its structure) to be used also for the tests prescribed by this standard.

- 2.4.5 The steering wheel, if adjustable, shall be placed in the normal position indicated by the manufacturer or, failing that, midway between the limits of its range(s) of adjustment.

## 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%.

### 3. RESULTS

- 3.1 To determine the rear- and upward movement of the steering control, a recording<sup>(1)</sup> shall be made, during the collision, of the variation in the distance - measured horizontally<sup>(2)</sup> and parallel to the longitudinal axis of the vehicle, and vertically, in the direction perpendicular to that axis - 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 rear- and upward 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.
- 3.3 Before and after the impact the dimensions specified in paragraph 5.1 of this standard shall be measured and recorded.

---

(1) This recording may be replaced by maximum measurements.

(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, and "vertically" is perpendicular to horizontally and upwards.

## 4. CORRECTION FACTORS

### 4.1 Notation

Recorded speed in km/h;

$v$  Recorded speed in km/hr

$m_o$  Mass of prototype in the state defined in paragraph 2.4. of this Annex;

$m_1$  Mass 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  $(48.3/v)^2$  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 standard shall be calculated by the following formula:

$$D_1 = D_o \cdot K_1 \cdot K_2$$

- 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 standard but whose mass  $m_1$  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

$$D_2 = \frac{m_1 \cdot D_1}{m_o}$$

is such as to show that the new vehicle still meets the requirements of paragraph 5 of this standard.

## 5. EQUIVALENT PROCEDURES

- 5.1 Alternative tests may be permitted at the discretion of the Approval Authority provided equivalence can be demonstrated. A report shall be attached to the approval documentation describing the method used and the results obtained or the reason for not carrying out the test.
- 5.2 Responsibility for demonstrating the equivalence of the alternative method shall rest with the manufacturer or his agent wishing to use such a method.

**ANNEX 2**

(See 4.1)

**BODY BLOCK TEST****1. PURPOSE**

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

**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  $\pm 2$  degrees of the design angle.

- 2.1.2 However, at the request of the manufacturer and with the agreement of the testing agency, 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.

- 2.1.3 Mounting of the steering control when seeking steering control approval only. The steering control shall be tested complete with trim. The steering control shall have a minimum collapsing space of 100 mm between the steering control and the test bench. The steering shaft shall be firmly attached to the test bench so that the steering shaft does not move under impact (see Figure 1a and 1b).

- 2.1.4 If the steering control is fitted with a steering wheel air-bag, the test shall be carried out with the air-bag inflated. At the request of the manufacturer and with the consent of the testing agency the test may be carried out without the air-bag inflated.



## **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 normal position indicated by the manufacturer or, failing that, midway between the limits of its range(s) of adjustment.
- 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.

## **2.3 Body Block**

The body block shall have the shape, dimensions, mass and characteristics shown in the Appendix 1 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 24.1km/h (+1.2, 0) i.e 15mph, (+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 standard shall enable the measurements to be made with the following accuracy:

2.7.1.1 Speed of body block: within 2 %;

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 analyzing the results of the test.

### 2.7.1.4 Measurement of Force

The instrumentation used shall comply with ISO 6487: 1987 unless otherwise specified in this standard.

2.7.1.4.1 With load transducers inserted on the steering system:

The channel amplitude class shall be 1 960 daN (2000 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 symmetrically 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: stabilised at  $20^{\circ}\text{C} \pm 5^{\circ}\text{C}$ .

## 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.

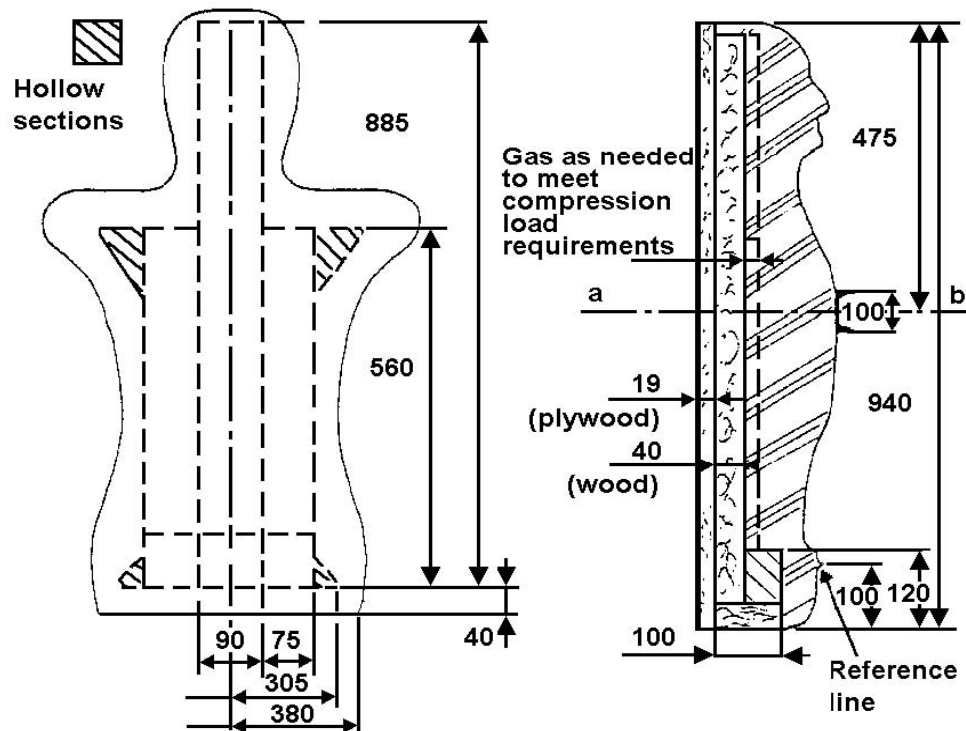
3.2 The maximum value of the force shall be measured or calculated as indicated in paragraph 2.4.

## ANNEX 2 – APPENDIX 1

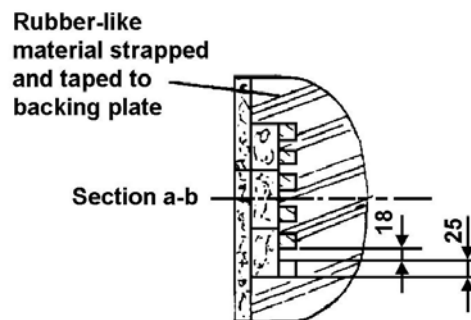
(See Annex 2 - 2.3)

**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 127 mm into the body block.



Dimensions in mm

**ANNEX 3**

(See 2.18)

**HEAD FORM TEST****1. PURPOSE**

The purpose of this test is to verify whether the steering control meets the requirements set out in paragraph 5.3. of this standard.

**2. INSTALLATIONS, PROCEDURES AND MEASURING INSTRUMENTS****2.1 General**

2.1.1 The steering control shall be tested complete with trim.

2.1.2 If the steering control is fitted with a steering wheel air-bag, the test shall be carried out with the air-bag inflated. At the request of the manufacturer and with the consent of the testing agency the test may be carried out without the air-bag inflated.

**2.2 Mounting of the Steering Control when seeking Steering Control Approval related to Vehicle Approval**

2.2.1 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 head form.

The tolerance on the control mounting angle shall be  $\pm 2$  degrees of the design angle.

2.2.2 However, at the request of the manufacturer and with the agreement of the testing agency, 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:

2.2.2.1 the same geometric layout,

2.2.2.2 greater rigidity.

**2.3 Mounting the Steering Control when seeking Steering Control Approval only**

The steering control shall be tested complete with trim. The steering control shall have a minimum collapsing space of 100 mm between the steering control and the test bench. The steering shaft shall be firmly attached to the test bench so that the steering shaft does not move under impact (see Figure 1a & 1b in Annex 2).

2.3.1 However, at the request of the manufacturer the test may be carried out under the conditions specified in paragraph 2.2. above. In such case the approval will only be valid for the specified type(s) of vehicle(s).

### 3. TEST APPARATUS

3.1 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.

3.2 The head-form shall be fitted with two accelerometers capable of measuring values in the impact direction.

#### 3.3 Measuring Instruments

3.3.1 The measuring instruments used shall comply with ISO 6487: 1987. In addition they shall have the following characteristics

##### 3.3.2 Acceleration

Channel amplitude class 150 g CAC  
Channel frequency class 600 Hz CFC.

##### 3.3.3 Speed

Accuracy to within  $\pm 1\%$

#### 3.4 Time Recording

The instrumentation shall enable the action to be recorded throughout its duration and the readings to be made with the accuracy to one-thousandth of a second. The beginning of the impact at the moment of first contact between the impactor and the steering control shall be noted on the recordings used for analyzing the test.

### 4 TEST PROCEDURE

4.1 The plane of the steering control shall be set up perpendicular to the direction of impact.

4.2 A maximum of four and a minimum of three positions on each steering control wheel type shall be impacted. A new steering control shall be used for each impact. On successive impacts the axial axis of the impactor shall be in line with one of the following points:

4.2.1 The centre of the steering control boss;

4.2.2 The joint of the stiffest or most supported spoke to the inner edge of the steering control rim;

4.2.3 The mid-point of the shortest unsupported area of the steering control rim that does not include a spoke when hit by the head form;

4.2.4 At the discretion of the type approving authority, the "worst case" position on the steering control.

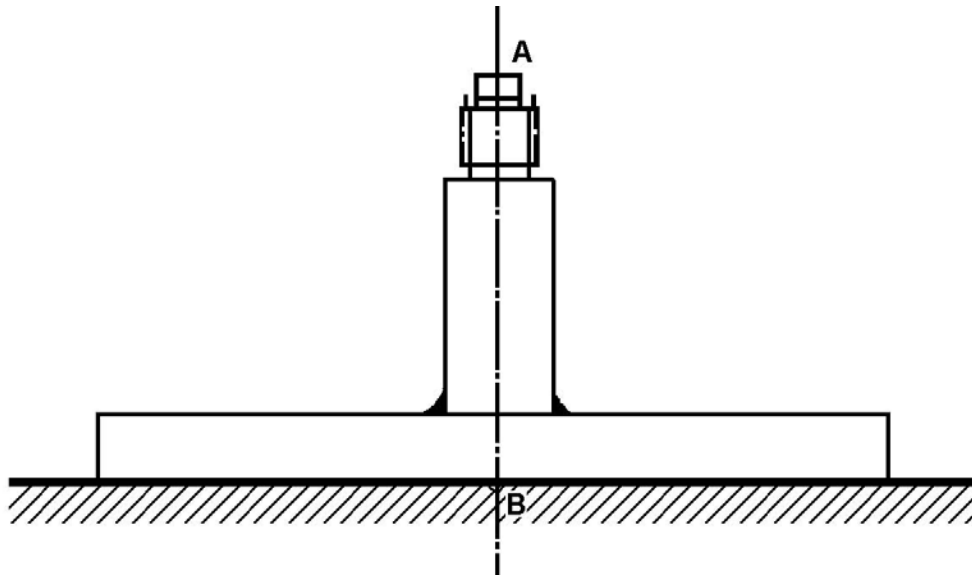
4.3 The impactor shall strike the steering control at a velocity of 24.1 km/h; this velocity shall be achieved either by the mere energy of propulsion or by using an additional propelling device.

**5 RESULTS**

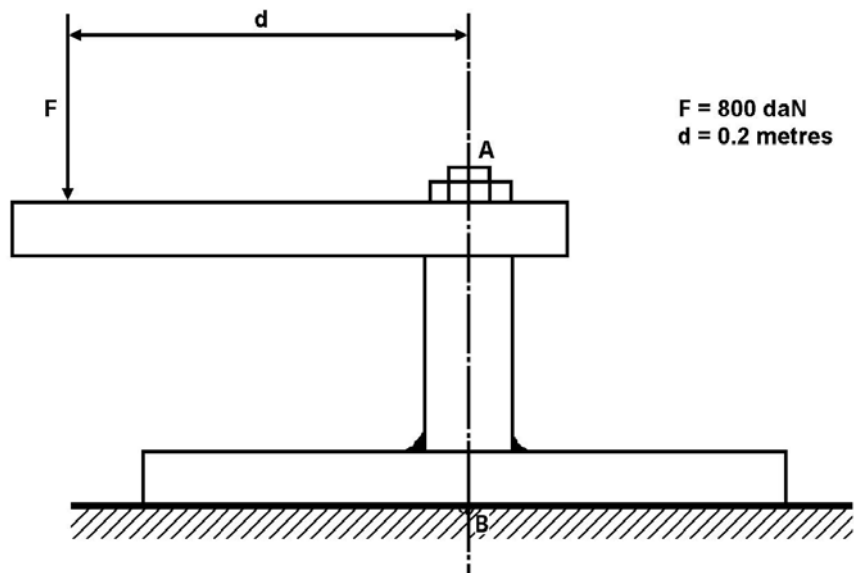
- 5.1 In the tests carried out according to the above procedures, the deceleration rate of the impactor shall be taken as the simultaneous average of the readings of the two decelerometers.

**6 EQUIVALENT PROCEDURES**

- 6.1 Alternative tests may be permitted at the discretion of the Approval Authority provided equivalence can be demonstrated. A report shall be attached to the approval documentation describing the method used and the results obtained.
- 6.2 Responsibility for demonstrating the equivalence of the alternative method shall rest with the manufacturer or his agent wishing to use such a method.



**Figure 1a**  
**Testing Set-up**



**Figure 1b**

**Measurement of the Testing Set-up Rigidity**

Under a load of 800 daN producing a couple of 160 m.daN in relation to the Point "B", the displacement in any direction of the Point "A" shall be lower than 2 mm.

**ANNEX 4**  
(See Introduction)

**COMMITTEE COMPOSITION \***  
**Automotive Industry Standards Committee**

<b>Chairman</b>	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
<b>Members</b>	<b>Representing</b>
Representative from	Ministry of Shipping, Road Transport & Highways (Dept. of Road Transport & Highways), New Delhi
Representative from	Ministry of Heavy Industries & Public Enterprises (Department of Heavy Industry), New Delhi
Shri Chandan Saha	Office of the Development Commissioner, Small Scale Industries, Ministry of Small Scale Industries, New Delhi
Shri Rakesh Kumar	Bureau of Indian Standards, New Delhi
Director Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Dr. M. O. Garg	Indian Institute of Petroleum, Dehra Dun
Dr. C. L. Dhamejani	Vehicles Research & Development Establishment, Ahmednagar
Representatives from	Society of Indian Automobile Manufacturers
Shri T.C. Gopalan Shri Ramakant Garg (Alternate)	Tractor Manufacturers Association, New Delhi
Shri K.N.D. Nambudiripad	Automotive Components Manufacturers Association of India, New Delhi
Shri Arvind Gupta	Automotive Components Manufacturers Association of India, New Delhi

Member Secretary  
Mrs. Rashmi Urdhwareshe  
Deputy Director  
The Automotive Research Association of India, Pune

\* At the time of approval of this Automotive Industry Standard (AIS)