

AMENDMENT NO. 4 13 April 2017

To

AIS-096

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

1. Page No. 11/21, Clause 3.3, Annex 1

Delete clause 3.3 :

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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 ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA
13 April 2017

AMENDMENT NO. 3 2 May 2017

To

AIS-096

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

1. Page No. III, Para 3, INTRODUCTION

Substitute following text for existing text:

“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.

The scope of this standard is extended to Quadricycle category L7 vehicles with reduced test speeds for frontal impact test, body block test and head form test. Amendment 3 to this standard is issued to cover these requirements appropriately.”

2. Page 1/21. Add new Clause 0.3, Scope

“**0.3** This standard also applies to the behavior of steering mechanism of Quadricycles of category L7 vehicles.”

3. Page 1/21. Clause 0.3, Scope

Renumber existing clause 0.3 to 0.4

4. Page 5/21, Clause 5.1, Specifications.

Substitute following text for existing text:

“5.1 When the vehicle in running order, without a manikin is collision tested against a barrier at a speed of 35 km/h in case quadricycle of category L7 and 48.3 km/h for other vehicles, as per Annex 1.”

5. Page 6/21, Clause 5.1.1, second para, Specifications.

Substitute following paragraph for second paragraph of existing text:

“5.1.1.

A vehicle other than quadricycle of category L7, 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”

6. **Page 6/21, Clause 5.2, Specifications.**

Substitute following text for existing text:

“**5.2** When the steering control is struck by a body block released against this control at a relative speed of 17.5 km/h in case quadricycle of category L7 and 24.1 km/h (15 mph) for other vehicles, the force applied to the body block by the steering control shall not exceed 1111 daN.”

7. **Page 6/21, Clause 5.3, Specifications.**

Substitute following text for existing text:

“**5.3** When the steering control is struck by an impactor released against this control at a relative speed of 17.5 km/h in case quadricycle of category L7 and 24.1 km/h for other vehicles, 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.”

8. **Page 10/21, Annex 1, Clause 2.5, Speed on Impact**

Substitute following text for existing text:

“**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) in case of vehicle other than quadricycle of category L7. For quadricycles of category L7, the speed on impact shall be between 32 km/h and 35 km/h. 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.”

9. **Page 12/21, clause 4.1, Notation for K_1**

Substitute following notation for K_1 for existing notation:

“ K_1 the greater of $(48.3/v)^2$ and 0.83 for vehicles other than quadricycle of category L7.

K_1 the greater of $(32/v)^2$ and 0.83 for quadricycle of category L7.”

10. **Page 14/21, Annex 2, Clause 2.6, Speed**

Substitute following text for existing text:

“**2.6** Speed

The body block shall strike the steering control at a speed of 17.5 km/h (+1.2, 0) in case of quadricycle of category L7 and 24.1 km/h (+1.2, 0) i.e 15mph, (+0.8, 0) for other vehicles. 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.”

11 **Page 18/21, Annex 3, Clause 4.3,**

Substitute following text for existing text:

“4.3 The impactor shall strike the steering control at a velocity of 17.5 km/h in case of quadricycle of category L7 and 24.1 km/h for other vehicles. This velocity shall be achieved either by the mere energy of propulsion or by using an additional propelling device.”

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(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA
2 May 2017

AMENDMENT NO. 2 28 September 2016

To

AIS-096

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

1. Page No. III , Para 5 , INTRODUCTION

Substitute following figure for existing one:

“UN R12 (Supp. 03 to 04 series of Amd.)”

2. Page 1/21. Clause 0.1, Scope

Substitute following text for existing text:

“0.1 This standard applies to the behavior of the steering mechanism and to the electrical power train operating on high voltage as well as the high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train, of motor vehicles of category N1 with maximum permissible mass < 1500 kg and of vehicles of category M1, with regard to the protection of the occupants in a frontal collision.”

3. Page 1/21. Clause 0.2, Scope

Delete existing clause 0.2:

4. Page 1/21. , Scope

Add new paragraph no. 0.2 to read as follows:

“0.2 The vehicles which have complied with the requirements of this standard shall be deemed to have complied with IS 11939: 1996.”

5. Page 4/21., Definitions

Add new definition in clause no. 2.33 as follows:

“2.33 Sharp Edge – An edge of a rigid material having radius of curvature of less than 2.5 mm except in case of projections of less than 3.2 mm, measured from the panel according to the procedure described in Annex C of

IS 15223: 2016. If the height of projection is less than 3.2 mm, the minimum radius of curvature shall not apply provided the height of the projection is not more than half its width and its edges are blunted. (See ANNEX F, explanatory notes, 3.14 of IS 15223: 2016)”

6. Page 6/21. Clause 5.4.1., Specifications

Substitute following text for existing text:

“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 165 mm in diameter shall present any roughness or sharp edges with a radius of curvature of less than 2.5 mm.

In the case of a steering control equipped with an airbag, this requirement shall be deemed satisfactory if no part, which can be contacted by a sphere of 165 mm diameter, contains any dangerous sharp edges, as defined in 2.33 likely to increase the risk of serious injury to the occupants.”

7. Page 5/15. Amendment 1

Substitute following text for existing text:

“5.5.1 Protection against electrical shock

After the impact at least one of the 4 criteria specified in paragraphs 5.5.1.1. to 5.5.1.4. shall be met.

If the vehicle has an automatic disconnect function or device(s) that galvanically divide the electrical power train circuit during driving condition, at least one of the following criteria shall apply to the disconnected circuit or to each divided circuit individually after the disconnect function is activated.

However criteria defined in 5.5.1.4. shall not apply if more than a single potential of a part of the high voltage bus is not protected under the conditions of protection degree IPXXB.

In the case that the test is performed under the condition that part(s) of the high voltage system are not energized, the protection against electrical shock shall be proved by either paragraph 5.5.1.3. or paragraph 5.5.1.4. below for the relevant part(s).

For the coupling system for charging the REESS, which is not energized during driving conditions, at least one of the 4 criteria specified in paragraphs 5.5.1.1. to 5.5.1.4. below shall be met.”

8. Page 14/21. ANNEX 2 – Body Block Test

Add new paragraph no. 2.4.3. as below:

“2.4.3.The test shall be carried out as per the method indicated by manufacturer as specified in paragraph 2.7.1.4.1. or paragraph 2.7.1.4.2.”

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SET-UP BY
MINISTRY OF ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA
28 September 2016

AMENDMENT NO. 1 15 December 2015

To

AIS-096

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

1. Page No. III, Para 5 , INTRODUCTION

Substitute following text for existing text:

UN R12 (Supp. 02 to 04 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
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2. Page No. III, Para 6, INTRODUCTION

Substitute following text for existing text and Add new para after para 6 as given below:

The Automotive Industry Standards Committee responsible for preparation of this standard is given in Annex: 5

Amendment No. 1 is issued to incorporate requirements for the protection of the occupants of vehicles operating on electrical power.

3. Page 1/21. Clause 0.1, Scope

Substitute following text for existing text:

0.1 This standard applies to the behavior of the steering mechanism and to the electrical power train operating on high voltage as well as the high voltage components and systems which are galvanically connected to the high voltage bus of the electric power train, of motor vehicles of category N1 with maximum mass <1500kg and of vehicles of category M1.

4. Page 1/21. Clause 2.1.1

Delete words “towards the rear”.

5. Page 2/21. Clause 2.1.1

Delete Clause 2.3.1.2.

6. Page 2/21. Clause 2.3.2.1.

Substitute following text for existing text and Add new sub clause “2.3.2.2.” after clause “2.3.2.1.” as given below:

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

2.3.2.2 The locations of the Rechargeable Electrical Energy Storage Systems (REESS), in so far as they have a negative effect on the result of the impact test prescribed in this Standard;

7. Page 3/21. Clause 2.17.

Substitute following text for existing text:

2.17 **“Passenger compartment”**

2.17.1 **"Passenger compartment with regard to occupant protection"** 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,

2.17.2 **"Passenger compartment for electric safety assessment"** means the space for occupant accommodation, bounded by the roof, floor, side walls, doors, outside glazing, front bulkhead and rear bulkhead, or rear gate, as well as by the electrical protection barriers and enclosures provided for protecting the occupants from direct contact with high voltage live parts.

8. Page 3/21. Clause 2.19.

Substitute following text for existing text:

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, spare wheel (if provided as standard equipment by the vehicle manufacturer) and REESS.

9. Page 3/21. Clause 2.23. to Clause 2.30.

Substitute following text for existing text:

2.23 **"High voltage"** means the classification of an electric component or circuit, if its working voltage is as follows–

60 V < working voltage (DC) ≤ 1500 V; or

30 V < working voltage (AC) rms ≤ 1000 V;

2.24 **"Rechargeable electrical energy storage system (REESS)"** means rechargeable electrical energy storage system which provides electrical energy for propulsion;

- 2.25 **"Electrical protection barrier"** the part providing protection against any direct contact to the high voltage live parts;
- 2.26 **"Electrical power train"** means the electrical circuit which includes the traction motor(s), and may also include the REESS, the electrical energy conversion system, the electronic converters, the associated wiring harness and connectors, and the coupling system for charging the REESS;
- 2.27 **"Live parts"** means conductive part(s) intended to be electrically energized in normal use;
- 2.28 **"Exposed conductive part"** means the conductive part which can be touched under the provisions of the protection degree IPXXB and which becomes electrically energized under isolation failure conditions. This includes parts under a cover that can be removed without using tools.
- 2.29 **"Direct contact"** means the contact of persons with high voltage live parts;
- 2.30 **"Indirect contact"** means the contact of persons with exposed conductive parts;

10. Page 3/21. Add new Clauses 2.31. to Clause 2.42. as below:

- 2.31 **"Protection Degree IPXXB"** means protection from contact with high voltage live parts provided by either an electrical protection barrier or an enclosure and tested using a Jointed Test Finger (Degree IPXXB) as described in paragraph 4. of Annex 4;
- 2.32 **"Working voltage"** means the highest value of an electrical circuit voltage root-mean-square (rms), specified by the vehicle manufacturer, which may occur between any conductive parts in open circuit conditions or under normal operating conditions. If the electrical circuit is divided by galvanic isolation, the working voltage is defined for each divided circuit, respectively;
- 2.33 **"Coupling system for charging the rechargeable electrical energy storage system (REESS)"** means the electrical circuit used for charging the REESS from an external electrical power supply including the vehicle inlet;
- 2.34 **"Electrical chassis"** means a set made of conductive parts electrically linked together, whose electrical potential is taken as reference;
- 2.35 **"Electrical circuit"** means an assembly of connected high voltage live parts which is designed to be electrically energized in normal operation;
- 2.36 **"Electric energy conversion system"** means a system that generates and provides electrical energy for electrical propulsion;
- 2.37 **"Electronic converter"** means a device capable of controlling and/or converting electrical power for electrical propulsion;
- 2.38 **"Enclosure"** means the part enclosing the internal units and providing protection against any direct contact;

- 2.39 **"High Voltage Bus"** means the electrical circuit, including the coupling system for charging the REESS that operates on a high voltage;
- 2.40 **"Solid insulator"** means the insulating coating of wiring harnesses provided in order to cover and prevent the high voltage live parts from any direct contact. This includes covers for insulating the high voltage live parts of connectors; and varnish or paint for the purpose of insulation;
- 2.41 **"Automatic disconnect"** means a device that when triggered, galvanically separates the electrical energy sources from the rest of the high voltage circuit of the electrical power train;
- 2.42 **"Open type traction battery"** means a type of battery requiring liquid and generating hydrogen gas released to the atmosphere.

11. Page 4/21.

Clause "2.31" (former) and "2.32" (former), re-number as Clause "2.43." and Clause "2.44."

12. Page 5/21. Clause 4.1.

Substitute following text for existing text:

4.1. **Vehicle Type**

"..... meets

- the requirements of paragraphs 5 and 6 below and Annexes 1, 2, 3
- and 4, in case of electrically powered vehicle,

.....be granted."

13. Page 6/21. Clause 5.1.2.

Substitute following text for existing text:

5.1.2. Additionally vehicles equipped with electrical power train shall meet requirements of paragraph 5.5. This could be demonstrated in a separate frontal impact test, at the request of the vehicle manufacturer, after validation by the Test Agency, given that the electric components do not influence the driver's protection performance of the vehicle type as defined in this Standard.

14. Page 6/21.

Delete subclauses **5.1.2.1. and 5.1.2.2.**

15. Page 7/21.

Add New Clause 5.5. (sub clauses 5.5.1, 5.5.1.1., 5.5.1.2., 5.5.1.3., 5.5.1.4., 5.5.1.4.1., 5.5.1.4.2., 5.5.2., 5.5.3.) and 5.6. as below,

5.5. Following the test, conducted in accordance with the procedure defined in Annex 1 to this Standard, the electrical power train operating on high voltage

and the high voltage components and systems, which are galvanically connected to the high voltage bus of the electrical power train, shall meet the following requirements:

5.5.1. **Protection against electrical shock**

After the impact at least one of the 4 criteria specified in paragraphs 5.5.1.1. to 5.5.1.4. shall be met.

If the vehicle has an automatic disconnect function or device(s) that galvanically divide the electrical power train circuit during driving condition, at least one of the following criteria shall apply to the disconnected circuit or to each divided circuit individually after the disconnect function is activated.

However criteria defined in 5.5.1.4. shall not apply if more than a single potential of a part of the high voltage bus is not protected under the conditions of protection degree IPXXB.

In the case that the test is performed under the condition that part(s) of the high voltage system are not energized, the protection against electrical shock shall be proved by either paragraph 5.5.1.3. or paragraph 5.5.1.4. below for the relevant part(s).

5.5.1.1. **Absence of high voltage**

The voltages V_b , V_1 and V_2 of the high voltage buses shall be $\leq 30 V_{AC}$ or $60 V_{DC}$, as specified in paragraph 2. of Annex 4.

5.5.1.2. **Low electrical energy**

The total energy (TE) on the high voltage buses shall be $< 2.0 J$ when measured according to the test procedure as specified in paragraph 3, formula (a) of Annex 4. Alternatively the total energy (TE) may be calculated by the measured voltage V_b of the high voltage bus and the capacitance of the X-capacitors (C_x) specified by the vehicle manufacturer in paragraph 3, formula (b) of Annex 4.

The energy stored in the Y-capacitors (TE_{y1} , TE_{y2}) shall also be $< 2.0 J$. This shall be calculated by measuring the voltages V_1 and V_2 of the high voltage buses and the electrical chassis, and the capacitance of the Y-capacitors specified by the vehicle manufacturer according to formula (c) in paragraph 3 of Annex 4.

5.5.1.3. **Physical protection**

For protection against direct contact with high voltage live parts, the protection degree IPXXB shall be provided.

In addition, for protection against electrical shock, which could arise from indirect contact, the resistance between all exposed conductive parts and the electrical chassis shall be $< 0.1 \Omega$ when there is current flow of at least 0.2 Amp.

This requirement is satisfied if the galvanic connection has been made by welding.

5.5.1.4. **Isolation resistance**

The criteria specified in the paragraphs 5.5.1.4.1. and 5.5.1.4.2. below shall be met. The measurement shall be conducted in accordance with paragraph 5. of Annex 4.

5.5.1.4.1. Electrical power train consisting of separate DC- or AC-buses

If the AC high voltage buses and the DC high voltage buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis (R_i as defined in paragraph 5. of Annex 4) shall have a minimum value of 100 Ω /volt of the working voltage for DC buses, and a minimum value of 500 Ω /volt of the working voltage for AC buses.

5.5.1.4.2. Electrical power train consisting of combined DC- and AC-buses.

If the AC high voltage buses and the DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis (R_i as defined in paragraph 5. of Annex 4) shall have a minimum value of 500 Ω /volt of the working voltage.

However, if the protection degree IPXXB is satisfied for all AC high voltage buses or the AC voltage ≤ 30 V after the vehicle impact, the isolation resistance between the high voltage bus and the electrical chassis (R_i as defined in paragraph 5 of Annex 4) shall have a minimum value of 100 Ω /volt of the working voltage.

5.5.2. **Electrolyte spillage**

In the period, from the impact until 30 minutes after, no electrolyte from the REESS shall spill into the passenger compartment, and no more than 7 % of electrolyte shall spill from the REESS except, open type traction batteries outside the passenger compartment. For open type traction batteries no more than 7 % with a maximum of 5.0 liters shall spill outside the passenger compartment. The vehicle manufacturer shall demonstrate compliance in accordance with paragraph 6. of Annex 4.

5.5.3. **REESS retention**

REESS located inside the passenger compartment shall remain in the location in which they are installed and REESS components shall remain inside REESS boundaries.

No part of any REESS that is located outside the passenger compartment for electrical safety assessment shall enter the passenger compartment during or after the impact test.

The manufacture shall demonstrate compliance in accordance with paragraph 7 of Annex 4.

- 5.6. Specifications of paragraphs 5.5. to 5.5.3. above are deemed to be met if the vehicle equipped with an electrical power train operating on high voltage complies with the relevant specifications of AIS-098 , Amendment 1.

16. Page 7/21.

Add following new sub Clause “6.1.1.” after Clause “6.1”:

- 6.1.1. Compliance with the requirements of paragraph 5.5 above shall be checked in accordance with the methods set out in Annex 4 to this standard. All measurements should be done on the basis of ISO 6487-1987

17. Page 9/21. Annex 1

Delete reference clause text “ (See 4.1)” as below:

ANNEX 1

18. Page 9/21. Annex 1, Clause 1

Substitute following text for existing text:

- 1 The purpose of this test is to verify whether the vehicle satisfies the requirements set forth in paragraph 5.1 and 5.5.

19. Page 10/21. Annex 1,

Add following New Clause 2.4.4. (With sub clauses 2.4.4.1., 2.4.4.2., 2.4.4.2.1., 2.4.4.2.2.) as below,

2.4.4. Electrical power train adjustment

- 2.4.4.1. The REESS shall be at any state of charge, which allows the normal operation of the power train as recommended by the vehicle manufacturer.

- 2.4.4.2. The electrical power train shall be energized with or without the operation of the original electrical energy sources (e.g. engine-generator, REESS or electric energy conversion system), however:

2.4.4.2.1. By the agreement between Test Agency and vehicle manufacturer it shall be permissible to perform the test with all or parts of the electrical power train not being energized in so far as there is no negative influence on the test result. For parts of the electrical power train not energized, the protection against electrical shock shall be proved by either physical protection or isolation resistance and appropriate additional evidence.

2.4.4.2.2. In the case where an automatic disconnect is provided, at the request of the vehicle manufacturer it shall be permissible to perform the test with the automatic disconnect being triggered. In this case it shall be demonstrated that the automatic disconnect would have operated during the impact test. This includes the automatic activation signal as well as the galvanic separation considering the conditions as seen during the impact.

20. Page 10/21. Annex 1

Clause “2.4.4.” (former) and “2.4.5.” (former), re-number as Clause “2.4.5.” and Clause “2.4.6.”

21. Page 12/21. Annex 1, Clause 4.3.

Substitute the words and figures “.....> m_0 , if $m_1 < 1.25 m_0$ ”

22. Page 13/21. Annex 2,

Delete reference clause text “ (See 4.1)” as below:

ANNEX 2

23. Page 16/21. ANNEX 2 – APPENDIX 1.

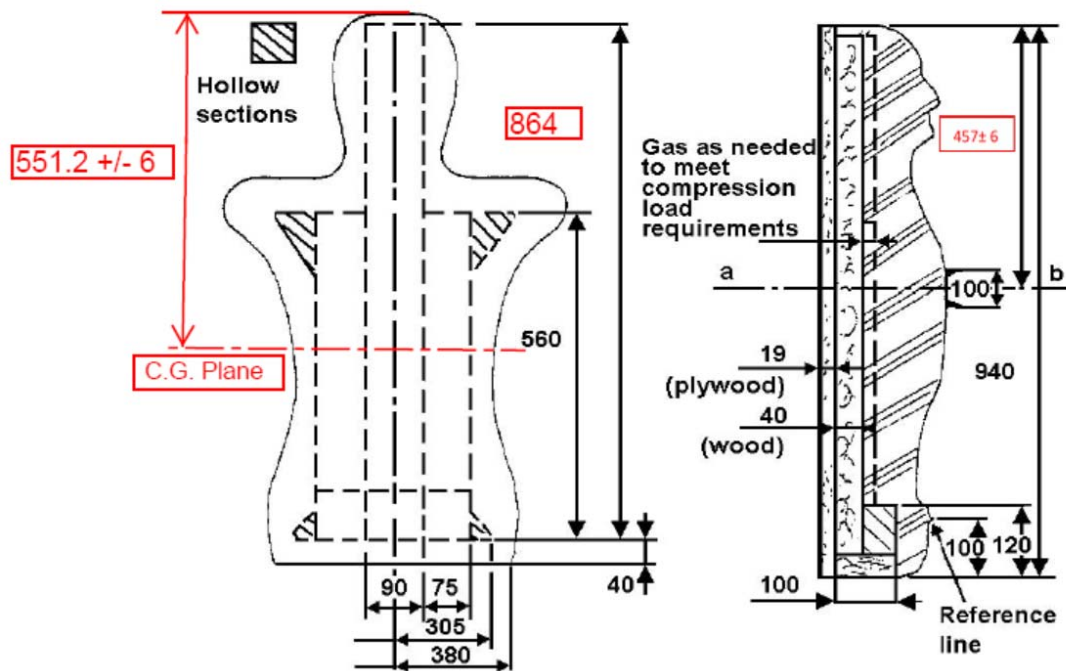
Substitute following text for existing text:

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

Following are non mandatory additional guidelines for mechanical properties of the bodyblock:

- (a) Rate of loading during stiffness measurement: 250 ± 50 mm/min;
- (b) Centre of gravity: 551.2 ± 6 mm from top of the body block;
- (c) Moment of inertia about lateral axis through centre of gravity: 2.26 ± 0.23 kg.m².

The chest is loaded

24. Page 17/21. Annex 3,

Delete reference clause text “(See 2.18)” as below:

ANNEX 3

**25. Add new section “Annex 4” and substitute title “Annex 5” to “Annex 4”(former)
as below:**

ANNEX 4

**Test Procedures for the protection of the occupants of vehicles operating on
electrical power from high voltage and electrolyte spillage**

This annex describes test procedures to demonstrate compliance to the electrical safety requirements of paragraph 5.5. For example, megohmmeter or oscilloscope measurements are an appropriate alternative to the procedure described below for measuring isolation resistance. In this case it may be necessary to deactivate the on-board isolation resistance monitoring system.

Before the vehicle impact test conducted, the high voltage bus voltage (V_b) (see figure 1) shall be measured and recorded to confirm that it is within the operating voltage of the vehicle as specified by the vehicle manufacturer.

1. Test setup and equipment

If a high voltage disconnect function is used, measurements are to be taken from both sides of the device performing the disconnect function.

However, if the high voltage disconnect is integral to the REESS or the electrical energy conversion system and the high-voltage bus of the REESS or the electrical energy conversion system is protected according to protection degree IPXXB following the impact test, measurements may only be taken between the device performing the disconnect function and the electrical loads.

The voltmeter used in this test shall measure DC values and have an internal resistance of at least 10 M Ω .

2. The following instructions may be used if voltage is measured.

After the impact test, determine the high voltage bus voltages (V_b , V_1 , V_2) (see figure 1).

The voltage measurement shall be made not earlier than 5 seconds but not later than 60 seconds after the impact.

This procedure is not applicable if the test is performed under the condition where the electrical power train is not energized.

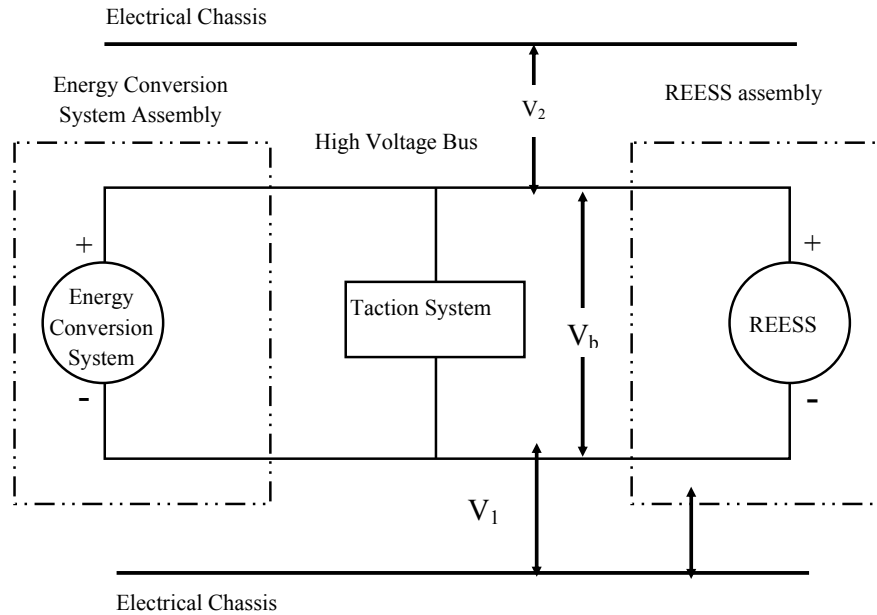


Figure 1 Measurement of V_b , V_1 , V_2

3. Assessment procedure for low electrical energy

Prior to the impact a switch S_1 and a known discharge resistor R_e is connected in parallel to the relevant capacitance (ref. figure 2).

Not earlier than 5 seconds and not later than 60 seconds after the impact the switch S_1 shall be closed while the voltage V_b and the current I_e are measured and recorded. The product of the voltage V_b and the current I_e shall be integrated over the period of time, starting from the moment when the switch S_1 is closed (t_c) until the voltage V_b falls below the high voltage threshold of 60 V DC (t_h). The resulting integration equals the total energy (TE) in J:

$$(a) \quad TE = \int_{t_c}^{t_h} V_b \times I_e dt$$

When V_b is measured at a point in time between 5 seconds and 60 seconds after the impact and the capacitance of the X-capacitors (C_x) is specified by the vehicle manufacturer, total energy (TE) shall be calculated according to the following formula:

$$(b) \quad TE = 0.5 \times C_x \times (V_b^2 - 3600)$$

When V_1 , V_2 (see figure 1) are measured at a point in time between 5 seconds and 60 seconds after the impact and the capacitances of the Y-capacitors (C_{y1} , C_{y2}) are specified by the vehicle manufacturer, total energy (TE_{y1} , TE_{y2}) shall be calculated according to the following formulas:

$$(c) \quad TE_{y1} = 0.5 \times C_{y1} \times (V_1^2 - 3600)$$

$$TE_{y2} = 0.5 \times C_{y2} \times (V_2^2 - 3600)$$

This procedure is not applicable if the test is performed under the condition where the electrical power train is not energized.

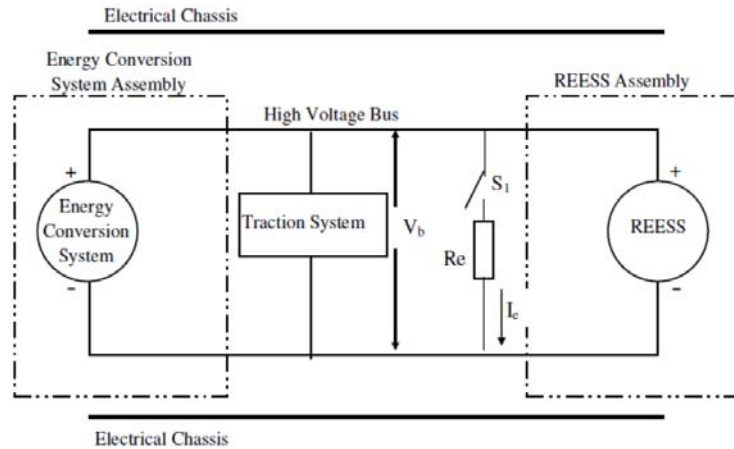


Figure 2 E.g. measurement of high voltage bus energy stored in X-capacitors

4. Physical protection

Following the vehicle impact test any parts surrounding the high voltage components shall be, without the use of tools, opened, disassembled or removed. All remaining surrounding parts shall be considered part of the physical protection.

The Jointed Test Finger described in Appendix 1 figure 1 shall be inserted into any gaps or openings of the physical protection with a test force of $10\text{ N} \pm 10\%$ for electrical safety assessment. If partial or full penetration into the physical protection by the Jointed Test Finger occurs, the Jointed Test Finger shall be placed in every position as specified below.

Starting from the straight position, both joints of the test finger shall be rotated progressively through an angle of up to 90 degrees with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.

Internal barriers are considered part of the enclosure.

If appropriate a low-voltage supply (of not less than 40 V and not more than 50 V) in series with a suitable lamp should be connected, between the Jointed Test Finger and high voltage live parts inside the electrical protection barrier or enclosure.

4.1. Acceptance conditions

The requirements of paragraph 5.5.1.3. shall be considered to be met if the Jointed Test Finger described in Annex 4, Appendix 1, figure 1 is unable to contact high voltage live parts.

If necessary a mirror or a fiberscope may be used in order to inspect whether the Jointed Test Finger touches the high voltage buses.

If this requirement is verified by a signal circuit between the Jointed Test Finger and high voltage live parts, the lamp shall not light.

5. Isolation resistance

The isolation resistance between the high voltage bus and the electrical chassis may be demonstrated either by measurement or by a combination of measurement and calculation.

The following instructions should be used if the isolation resistance is demonstrated by measurement.

Measure and record the voltage (V_b) between the negative and the positive side of the high voltage bus (see figure 1):

Measure and record the voltage (V_1) between the negative side of the high voltage bus and the electrical chassis (see figure 1):

Measure and record the voltage (V_2) between the positive side of the high voltage bus and the electrical chassis (see figure 1):

If V_1 is greater than or equal to V_2 , insert a standard known resistance (R_o) between the negative side of the high voltage bus and the electrical chassis. With R_o installed, measure the voltage (V_1') between the negative side of the high voltage bus and the vehicle electrical chassis (see figure 3). Calculate the isolation resistance (R_i) according to the formula shown below.

$$R_i = R_o * (V_b / V_1' - V_b / V_1) \quad \text{or} \quad R_i = R_o * V_b * (1 / V_1' - 1 / V_1)$$

Divide R_i , which is the electrical isolation resistance value (in Ω) by the working voltage of the high voltage bus in volt (V).

$$R_i (\Omega / V) = R_i (\Omega) / \text{Working voltage (V)}$$

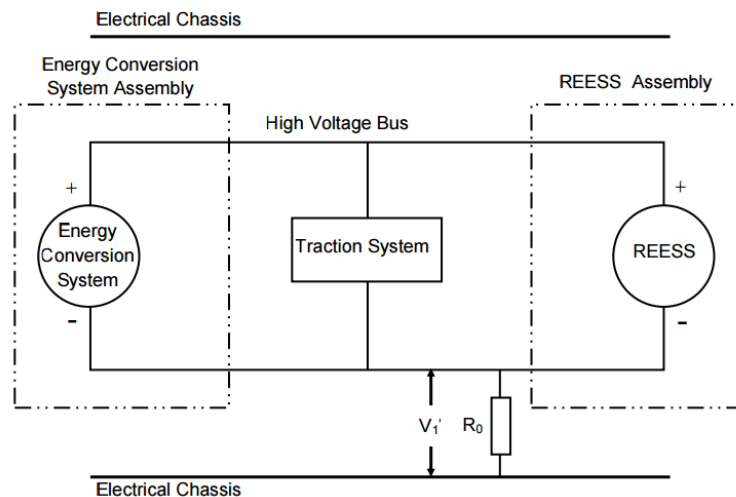


Figure 3 Measurement of V_1'

If $V_2 > V_1$, insert a standard known resistance (R_o) between the positive side of the high voltage bus and the electrical chassis. With R_o installed, measure the voltage (V_2') between the positive side of the high voltage bus and the electrical chassis (see figure 4).

Calculate the isolation resistance (R_i) according to the formula shown below.

$$R_i = R_o * (V_b / V_2' - V_b / V_2) \quad \text{or} \quad R_i = R_o * V_b * (1 / V_2' - 1 / V_2)$$

Divide R_i , which is the electrical isolation resistance value (in Ω) by the working voltage of the high voltage bus in volt (V).

$$R_i (\Omega / V) = R_i (\Omega) / \text{Working voltage (V)}$$

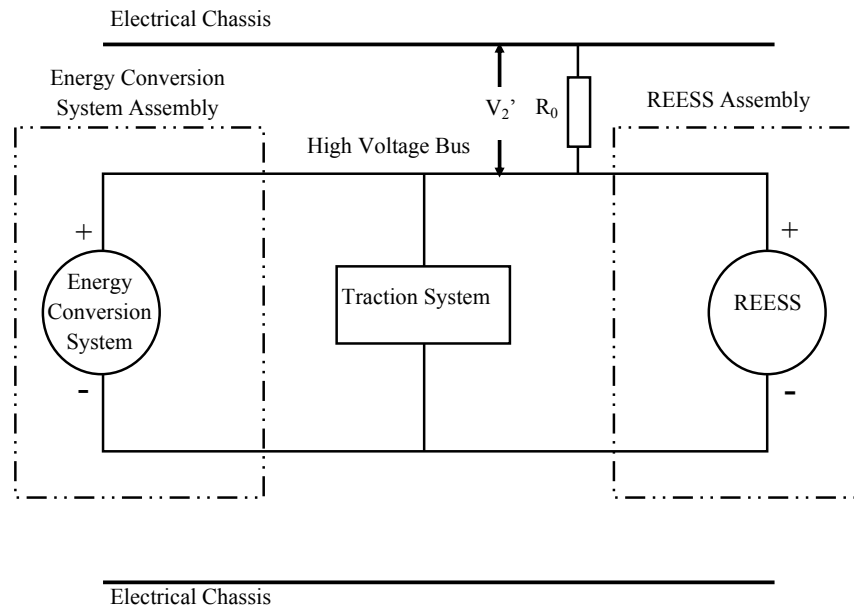


Figure 4 Measurement of V_2'

Note: The standard known resistance R_o (Ω) should be the value of the minimum required isolation resistance (Ω / V) multiplied by the working voltage of the vehicle $\pm 20\%$. R_o is not required to be precisely this value since the equations are valid for any R_o ; however, an R_o value in this range should provide a good resolution for the voltage measurements.

6. Electrolyte spillage

Appropriate coating shall be applied, if necessary, to the physical protection in order to confirm any electrolyte leakage from the REESS after the impact test.

Unless the vehicle manufacturer provides means to differentiate between the leakage of different liquids, all liquid leakage shall be considered as the electrolyte.

7. REESS retention

Compliance shall be determined by visual inspection.

Annex 4 – Appendix 1

(See 2.31)

Jointed Test Finger (Degree IPXXB)

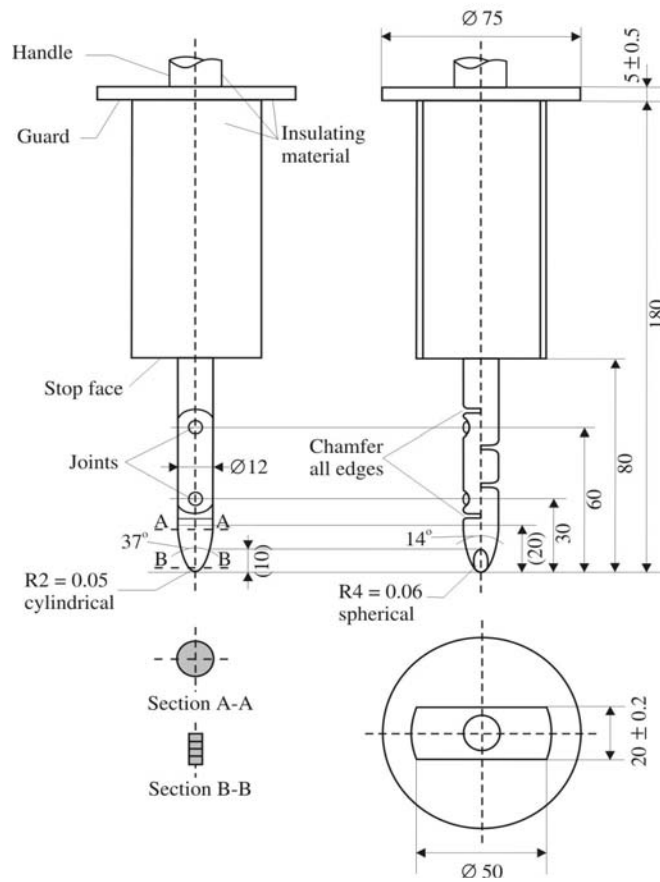


Figure 1 Jointed test finger

Material: metal, except where otherwise specified
Linear dimensions in millimeters

Tolerances on dimensions without specific tolerance:

- (a) On angles: 0/-10 degrees
- (b) On linear dimensions: up to 25 mm: 0/-0.05 mm over 25 mm: ± 0.2 mm
Both joints shall permit movement in the same plane and the same direction through an angle of 90° with a 0 to $+10^\circ$ tolerance.

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ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE
UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE
SET-UP BY
MINISTRY OF ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA
15 December 2015

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

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 50th 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 ± 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 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⁽¹⁾ shall be made, during the collision, of the variation in the distance - measured horizontally⁽²⁾ 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_0 Mass of prototype in the state defined in paragraph 2.4. of this Annex;

m_1 Mass of prototype with testing apparatus;

D_0 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 $\frac{m_0}{m_1}$ 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:

$$D_1 = D_0 \cdot K_1 \cdot K_2$$

- 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_0 , if m_1 is not more than 1.25 m_0 and if the corrected variation D_2 obtained from the variation D_1 by the formula

$$D_2 = \frac{m_1 \cdot D_1}{m_0}$$

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 ± 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 blocks 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.

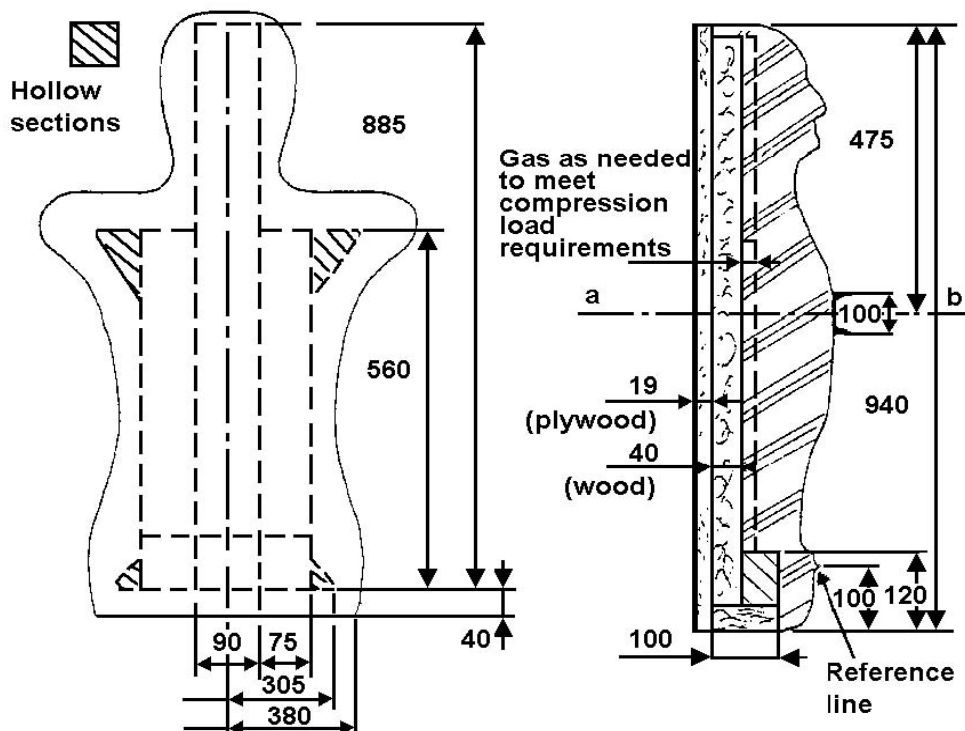
3.2 The maximum value of the force shall be measured or calculated as indicated in paragraph 2.4.

ANNEX 2 – APPENDIX 1

(See Annex 2 - 2.3)

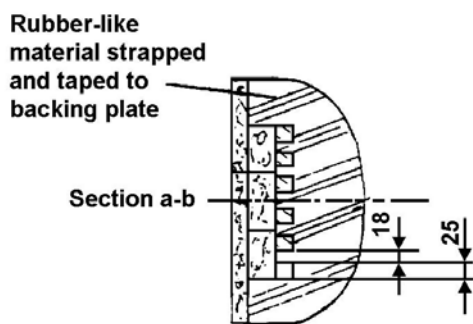
BODY BLOCK

(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 ± 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.

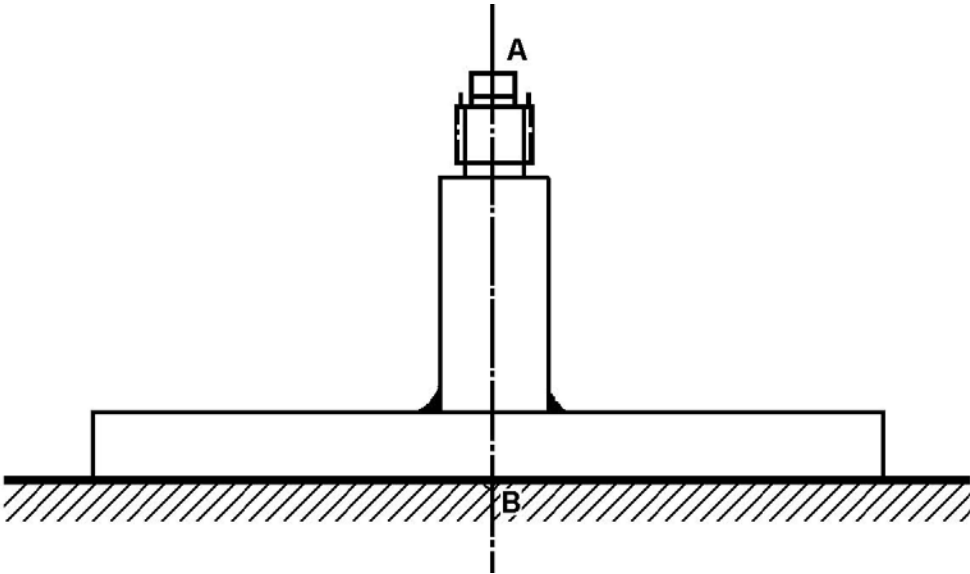


Figure 1a
Testing Set-up

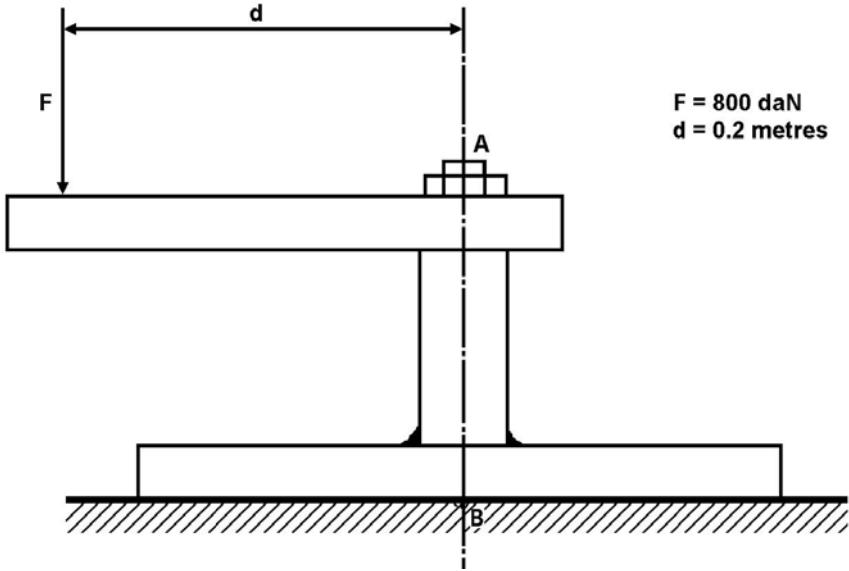


Figure 1b

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

Chairman	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
Members	Representing
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)