Amendment 1 19th December 2017
to
AIS-038(Rev.1)
Electric Power Train Vehicles-Construction and Functional Safety Requirements

1 Page 5/19

Add new clause 3.3.5 as below :

3.3.5 There shall also be an optical / visual indication to the driver when state of charge of the REESS reaches a level where re-charging is recommended, this indication shall remain ON, even if the vehicle is restarted, till the vehicle is charged above the charge level where re-charging is recommended. In case vehicle has an indicator or display which shows continuously the state-of-charge (SOC) level of REESS to the driver, the provision of indication mentioned in this clause is optional.

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 VEHICLES RULES - TECHNICAL STANDING COMMITTEE

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

19th December 2017

AUTOMOTIVE INDUSTRY STANDARDS

Electric Power Train Vehicles- Construction and Functional Safety Requirements

(Revision 1)

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 ROAD TRANSPORT & HIGHWAYS
(DEPARTMENT OF ROAD TRANSPORT & HIGHWAYS)
GOVERNMENT OF INDIA

February 2015

Status chart of the Standard to be used by the Purchaser for updating the record

Sr. No.	Corrigenda	Amend-ment	Revision	Date	Remark	Misc.

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 of preparation of 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 Standard 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. For better dissemination of this information, ARAI may publish this standard on their website.

This standard prescribes the requirements for the construction and functional safety of Electric Power Train Vehicles.

Considerable assistance has been taken from UN ECE R 100 (Supplement 1 to the 02 series of amendments, Date of entry into force: 10.06.14 Excluding Part II Applicable for safety requirements for Rechargeable Energy Storage System (REESS),): Uniform Provisions Concerning the Approval of Vehicles with regard to Specific Requirements for the Electric Power Train

The AISC panel and the Automotive Industry Standards Committee (AISC) responsible for preparation of this standard are given in Annex E and Annex F respectively.

Electric Power Train Vehicles - Construction and Functional Safety Requirements

Contents

Electric Power Train Vehicles - Construction and Functional Safety Rrequirements

1 SCOPE

This standard specifies the construction and functional safety requirements for L, M and N categories of electric power train vehicles as defined in Rule 2 (u) of CMVR.

2 DEFINITIONS

Refer AIS-049:2003, as amended and revised from time to time, for the definitions.

3 SPECIFICATION AND TESTS

3.1 Protection against electric shock

These electrical safety requirements apply to high voltage buses (as defined in AIS-049:2003, as amended and revised from time to time under conditions where they are not connected to external high voltage power supplies.

3.1.1 Protection against direct contact

The protection against direct contact with live parts shall comply with paragraphs 3.1.1.1. and 3.1.1.2. These protections (solid insulator, barrier, enclosure, etc.) shall not be able to be opened, disassembled or removed without the use of tools.

3.1.1.1 For protection of live parts inside the passenger compartment or luggage compartment, the protection degree IPXXD as given in Annex A shall be provided.

3.1.1.2 For protection of live parts in areas other than the passenger compartment or luggage compartment, the protection degree IPXXB as given in Annex A shall be satisfied.

In case of open L category vehicles where luggage compartment and passenger compartment are not clearly distinguished, for protection of live parts inside areas which can be accessed only with use of tools, the protection degree IPXXB shall be provided and for other live parts protection degree IPXXD shall be provided.

Note: Accessing an area by opening a lock with a key is not considered as using a tool

3.1.1.3 Connectors

Connectors (including vehicle inlet) are deemed to meet this requirement if:

(a) They comply with 3.1.1.1. and 3.1.1.2. when separated without the use of tools, or
(b) They are located underneath the floor and are provided with a locking mechanism, or
(c) They are provided with a locking mechanism and other components shall be removed with the use of tools in order to separate the connector, or
(d) The voltage of the live parts becomes equal or below DC 60V or equal or below AC 30V (rms) within one second after the connector is separated.

3.1.1.4 **Service disconnect**

For a service disconnect which can be opened, disassembled or removed without tools, it is acceptable if protection degree IPXXB is satisfied under a condition where it is opened, disassembled or removed without tools.

3.1.1.5 **Marking**

3.1.1.5.1 In the case of a REESS having high voltage capability the symbol shown in Figure 1 shall appear on or near the REESS. The symbol background shall be yellow, the bordering and the arrow shall be black.

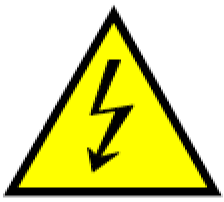


Figure 1
Marking of High Voltage Equipment

3.1.1.5.2 The symbol shall also be visible on enclosures and barriers, which, when removed expose live parts of high voltage circuits. This provision is optional to any connector for high voltage buses. This provision shall not apply to any of the following cases:

(a) Where barriers or enclosures cannot be physically accessed, opened, or removed; unless other vehicle components are removed with the use of tools;

(b) Where barriers or enclosures are located underneath the vehicle floor.

3.1.1.5.3 Cables for high voltage buses which are not located within enclosures shall be identified by having an outer covering with the colour orange.

3.1.2 **Protection against indirect contact**

3.1.2.1 For protection against electrical shock which could arise from indirect contact, the exposed conductive parts, such as the conductive barrier and enclosure, shall be galvanically connected securely to the electrical chassis by connection with electrical wire or ground cable, or by welding, or by connection using bolts, etc. so that no dangerous potentials are produced.

3.1.2.2 The resistance between all exposed conductive parts and the electrical chassis shall be lower than 0.1 ohm when there is current flow of at least 0.2 amperes. This requirement is satisfied if the galvanic connection has been established by welding.

3.1.2.3 In the case of motor vehicles which are intended to be connected to the grounded external electric power supply through the conductive connection, a device to enable the galvanical connection of the electrical chassis to the earth ground shall be provided. The device should enable connection to the earth ground before exterior voltage is applied to the vehicle and retain the connection until after the exterior voltage is removed from the vehicle. Compliance to this requirement may be demonstrated either by using the connector specified by the car manufacturer, or by analysis.

3.1.3 Isolation resistance

This paragraph shall not apply to vehicles having chassis connected electrical circuits where the maximum voltage between any live part and the electrical chassis or any exposed conductive part does not exceed 30V AC (rms) or 60 V DC.

3.1.3.1 Electric power train consisting of separate Direct Current- or Alternating Current-buses. If AC high voltage buses and DC high voltage buses are galvanically isolated from each other, isolation resistance between the high voltage bus and the electrical chassis 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. The measurement shall be conducted according to Annex B "Isolation resistance measurement method for vehicle based tests”.

3.1.3.2 Electric power train consisting of combined DC- and AC-buses. If AC high voltage buses and DC high voltage buses are galvanically connected isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 500 Ω/volt of the working voltage.

However, if all AC high voltage buses are protected by one of the 2 following measures, isolation resistance between the high voltage bus and the electrical chassis shall have a minimum value of 100 Ω/V of the working voltage:

(a) Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 3.1.1. Independently, for example wiring harness;
(b) Mechanically robust protections that have sufficient durability over vehicle service life such as motor housing, electronic converter cases or connectors.

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

The measurement shall be conducted according to Annex B "Isolation resistance measurement method for vehicle based tests".

3.1.3.3 Fuel cell vehicles

If the minimum isolation resistance requirement cannot be maintained over time, then protection shall be achieved by any of the following:

(a) Double or more layers of solid insulators, barriers or enclosures that meet the requirement in paragraph 3.1.1. independently;

(b) On-board isolation resistance monitoring system together with a warning to the driver if the isolation resistance drops below the minimum required value. The isolation resistance between the high voltage bus of the coupling system for charging the REESS, which is not energized besides during charging the REESS, and the electrical chassis need not be monitored. The function of the on-board isolation resistance monitoring system shall be confirmed as described in Annex C.

3.1.3.4 Isolation resistance requirement for the coupling system for charging the REESS

For the vehicle inlet intended to be conductively connected to the grounded external AC power supply and the electrical circuit that is galvanically connected to the vehicle during charging the REESS, the isolation resistance between the high voltage bus and the electrical chassis shall be at least 1MΩ when the charger coupler is disconnected. During the measurement, the traction REESS may be disconnected.

3.2 Rechargeable Energy Storage System (REESS)

3.2.1 Protection against excessive current

The REESS shall not overheat. If the REESS is subject to overheating due to excessive current, it shall be equipped with a protective device such as fuses, circuit breakers or main contactors. However, the requirement may not apply if the manufacturer supplies data that ensure that overheating from excessive current is prevented without the protective device.

3.2.2 Accumulation of gas

Places for containing open type traction REESS that may produce hydrogen gas shall be provided with a ventilation fan or a ventilation duct to prevent the accumulation of hydrogen gas.

3.3 Functional Safety

3.3.1 At least a momentary indication shall be given to the driver when the vehicle is in "active driving possible mode".

3.3.2 When leaving the vehicle, the driver shall be informed by a signal (e.g. optical or audible signal) if the vehicle is still in the active driving possible mode. The condition shall be deemed to be satisfied if the indication specified in 3.3.1 above is not momentary and continues to be displayed.

3.3.3 If the on-board REESS can be externally charged by the user, vehicle movement by its own propulsion system shall be impossible as long as the connector of the external electric power supply is physically connected to the vehicle inlet. This requirement shall be demonstrated by using the connector specified by the car manufacturer.

3.3.4 The state of the drive direction control unit shall be identified to the driver.

3.4 Creepage Distance Measurements for Open Type of REESS

This clause deals with additional leakage current hazard between the connection terminals of a REESS module including any conductive fittings attached to them and any conductive parts, due to the risk of electrolyte spillage in normal operating conditions. It does not apply to traction batteries, for which electrolyte leakage will not occur under normal operating conditions e.g. sealed traction batteries.

The minimum creepage distance shall be as follows:

a)	In the case of a creepage distance between two battery connection terminals:
	$d \geq 0.25\ U + 5$;
	Where d is the creepage distance measured on the tested REESS in mm. U is the nominal voltage between the two battery connection terminals in V.
b)	In the case of creepage distance between live parts and the electrical chassis:
	$d \geq 0.125\ U + 5$;
	Where d is the creepage distance measured between the live part and the electrical chassis in mm. U is the nominal voltage between the two battery connection terminals in V.

3.5 **Protection against Water Effects**

The test as per 3.5.1, 3.5.2 and 3.5.3 shall be performed. After each exposure (vehicles still wet), the vehicle shall then comply with the isolation resistance test with at least 100 Ω/V of nominal voltage, but keeping the power equipment connected to the REESS (main switch closed), and before water test isolation resistance with at least 500 Ω/V of nominal voltage.

These tests shall not apply to vehicles having chassis connected electrical circuits where the maximum voltage between any live part and the electrical chassis or any exposed conductive part does not exceed 30V AC (rms) or 60 V DC.

3.5.1 **Washing**

This test is intended to simulate a normal washing of Electric Power Train vehicles, but not specific cleaning using high water pressure or underbody washing. The vehicle manufacturer shall specify detailed conditions for such specific cleaning or washing in the owner's manual. The critical areas of the vehicle regarding this test are border lines i.e. a seal of two parts as flaps, glass seals, outline of opening parts, outline of front grille, seals of lamps.

In the case of open vehicles such as 3-wheelers without doors and windows, or 2-wheelers etc the manufacturer shall specify the procedure for normal washing also. In such cases, the washing test shall be conducted by taking into account the above recommendation.

The test uses a hose nozzle according to IPX5 as specified in IEC 60529 (Refer Annex-D for details). Using fresh water with a flow rate of 12.5 l/min, all borderlines shall be exposed and followed in all directions with the water stream at a speed rate of 0.1 m/s, keeping a distance of 3 m between the nozzle aperture and the borderline.

3.5.2 **Flooding**

This test is intended to simulate the driving of an Electric Power Train vehicles on flooded streets or in water puddles.

The vehicle shall be driven in a wade pool, 10 cm in depth, over a distance of 500 m at a speed of 20 km/h resulting in a time of approximately 1.5 min.

If the wade pool used is less than 500 m in length, so that it has to be driven through several times, the total time including the periods outside the wade pool shall be less than 10 min.

3.5.3 **Heavy Rainstorm**

This test is intended to simulate a sudden heavy rainstorm e.g. a thunderstorm, when opening parts especially to access to the passenger, load and motor compartments are open except those requiring one or more tools.

In case of voltage class B equipment shielded from exposure to water, this test of the whole vehicle may be replaced by equivalent tests on the components individually.

The critical areas of the vehicle regarding this test are those accessible with opened opening parts.

This test uses a spray nozzle according to IPX3 as specified in IEC 60529.

Using fresh water with a flow rate of 10 l/min, all surfaces with normally open opening parts shall be exposed for 5 min, possibly through a regular movement of the spray nozzle.

Note : Voltage class B equipment is an equipment with nominal voltage (U)

DC: 60 V < U <= 1500 V

AC: 25 V rms < U < = 1000 V rms – 15 to 150 Hz

4.0 TECHNICAL SPECIFICATIONS

The details of technical specification, approvals of changes in specification shall be as per para 5.0 of AIS-049:2003, as amended and revised from time to time.

5.0 TRANSITIONAL PROVISIONS

5.1 General guidelines for transitional provisions for this standard shall be as per AIS-000, as amended from time to time, as applicable, with the following additional requirements.

5.2 Type approvals issued for compliance to AIS-038-2003 shall be extended to approval of AIS-038 (Rev.1) 2015 subject to satisfactory compliance of the following:

5.2.1 Requirement set out in 3.1.1.3 with respect to protection against Electric Shock (Connectors)

5.2.2 The Cables for high voltage buses which are located underneath the vehicle floor shall be identified by having an outer covering with the colour orange. (Requirements set out in 3.1.1.5.3)

5.2.3 Provision of Service Disconnect with the protection degree of IPXXB as per clause 3.1.1.4.

5.2.4 The clause 3.1.2.3 for motor vehicles intended to be connected to the grounded external electric power is met.

5.2.5 The isolation resistance mentioned in 3.1.3.

5.2.6 Functional safety requirements in 3.3.

ANNEX-A
(See 3.1.3.1)

PROTECTION AGAINST DIRECT CONTACT OF PARTS UNDER VOLTAGE

1 ACCESS PROBES

Access probes to verify the protection of persons against access to hazardous parts are given in Table 1.

2 TEST CONDITIONS

The access probe is pushed against any openings of the enclosure with the force specified in Table 1. If it partly or fully penetrates, it is placed in every possible position, but in no case shall the stop face fully penetrate through the opening.

Internal barriers are considered part of the enclosure.

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, if necessary, between the probe and live parts inside the barrier or enclosure.

The signal-circuit method should also be applied to the moving live parts of high voltage equipment.

Internal moving parts may be operated slowly, where this is possible.

3 ACCEPTANCE CONDITIONS

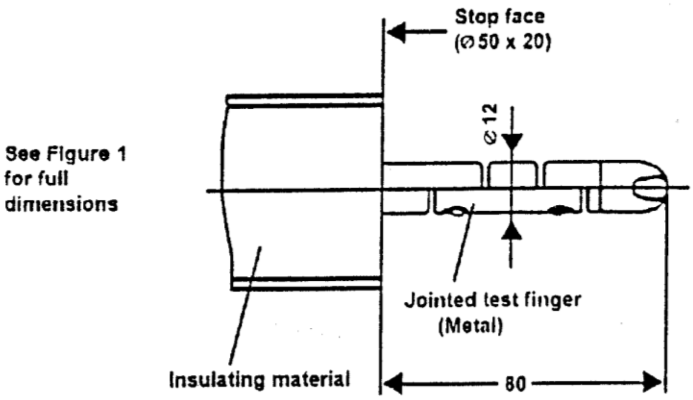
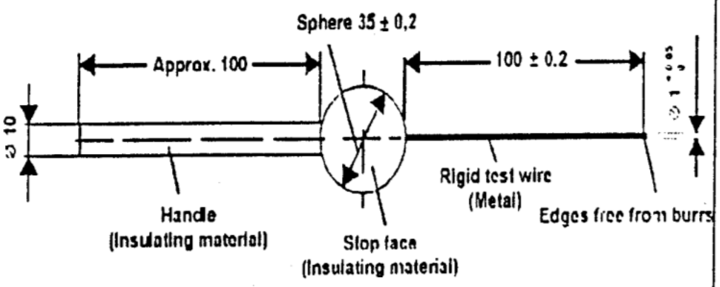
The access probe shall not touch live parts.

If this requirement is verified by a signal circuit between the probe and live parts, the lamp shall not light.

In the case of the test for IPXXB, the jointed test finger may penetrate to its 80 mm length, but the stop face (diameter 50 mm x 20 mm) shall not pass through the opening. Starting from the straight position, both joints of the test finger shall be successively bent through an angle of up to 90 degree with respect to the axis of the adjoining section of the finger and shall be placed in every possible position.

In case of the tests for IPXXD, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening.

TABLE – 1
ACCESS PROBES FOR THE TESTS FOR PROTECTION OF PERSONS AGAINST ACCESS TO HAZARDOUS PARTS

<table>
<tr><td>B</td><td>* Jointed test finger

</td><td>10 N ± 10%</td></tr>
<tr><td>D</td><td>Test wire 1,0 mm diameter 100 mm long

</td><td>1 N ± 10%</td></tr>
</table>

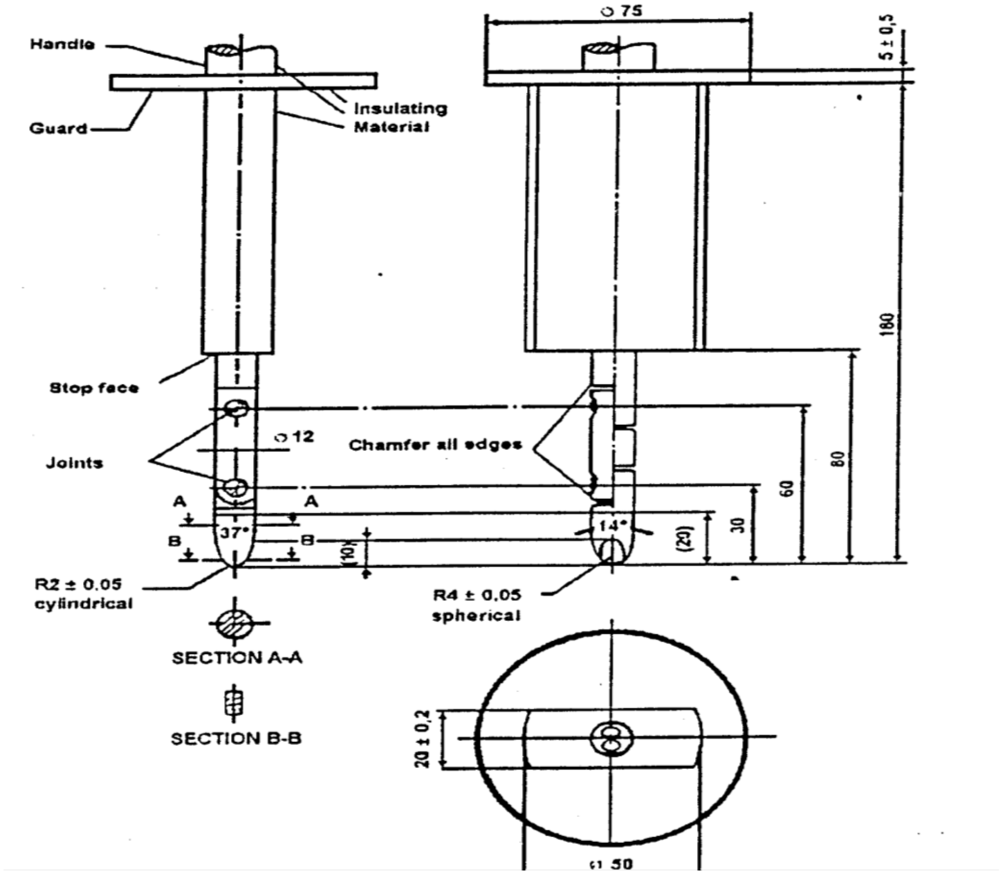


Figure 1

JOINTED TEST FINGER

Material: Metal, except where otherwise specified

Linear dimension in millimeters

Tolerance on dimension without specific tolerance:

(a) No angles: 0/-10⁰

(b) On linear dimensions: up to 25mm: 0/-0/05mm over 25mm ±0.2mm

Both joints shall permit movement in the same plane and the same direction through an angle of 90⁰ with a 0 to 10⁰ tolerance.

ANNEX- B
(See 3.1.3.1)

ISOLATION RESISTANCE MEASUREMENT METHOD FOR VEHICLE BASED TESTS

1 GENERAL

The isolation resistance for each high voltage bus of the vehicle shall be measured or shall be determined by calculation using measurement values from each part or component unit of a high voltage bus (hereinafter referred to as the "divided measurement").

2 MEASUREMENT METHOD

The isolation resistance measurement shall be conducted by selecting an appropriate measurement method from among those listed in paragraphs 2.1. through 2.2., depending on the electrical charge of the live parts or the isolation resistance, etc.

The range of the electrical circuit to be measured shall be clarified in advance, using electrical circuit diagrams, etc.

Moreover, modification necessary for measuring the isolation resistance may be carried out, such as removal of the cover in order to reach the live parts, drawing of measurement lines, change in software, etc.

In cases where the measured values are not stable due to the operation of the on-board isolation resistance monitoring system, etc., necessary modification for conducting the measurement may be carried out, such as stopping of the operation of the device concerned or removing it. Furthermore, when the device is removed, it shall be proven, using drawings, etc., that it will not change the isolation resistance between the live parts and the electrical chassis.

Utmost care shall be exercised as to short circuit, electric shock, etc., for this confirmation might require direct operations of the high-voltage circuit.

2.1 Measurement method using voltage from off-vehicle sources

2.1.1 Measurement Instrument

An isolation resistance test instrument capable of applying a DC voltage higher than the working voltage of the high voltage bus shall be used.

2.1.2 Measurement method

An insulator resistance test instrument shall be connected between the live parts and the electrical chassis.

Then, the isolation resistance shall be measured by applying a DC voltage at least half of the working voltage of the high voltage bus. If the system has several voltage ranges (e.g. because of boost converter) in galvanically connected circuit and some of the components cannot withstand the working voltage of the entire circuit, the isolation resistance between those components and the electrical chassis can be measured separately by applying at least half of their own working voltage with those component disconnected.

2.2 Measurement method using the vehicle's own REESS as DC voltage source.

2.2.1 Test vehicle conditions

The high voltage-bus shall be energized by the vehicle's own REESS and/or energy conversion system and the voltage level of the REESS and/or energy conversion system throughout the test shall be at least the nominal operating voltage as specified by the vehicle manufacturer.

2.2.2 Measurement instrument

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

2.2.3 Measurement method

2.2.3.1 First Step

The voltage is measured as shown in Figure 1 and the high voltage bus voltage (V_b) is recorded. V_b shall be equal to or greater than the nominal operating voltage of the REESS and/or energy conversion system as specified by the vehicle manufacturer.

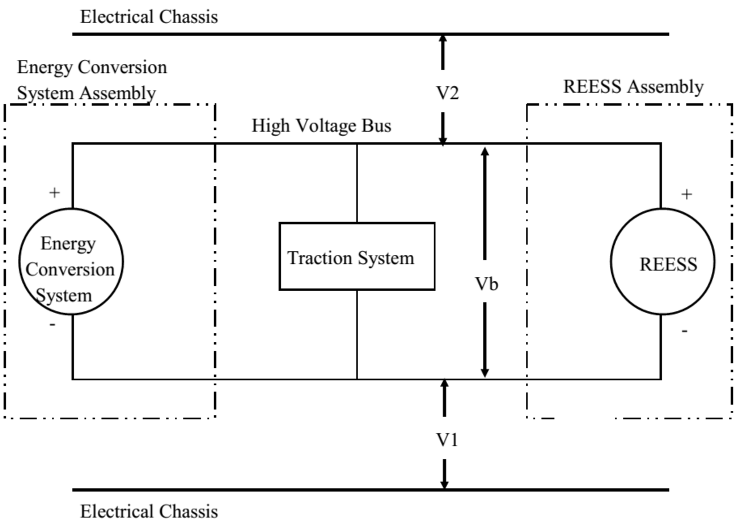


Figure 1
Measurement of V_b, V_1, V_2

2.2.3.2 Second step

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

2.2.3.3 Third Step

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

2.2.3.4 Fourth step

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 electrical chassis (see Figure 2).

Calculate the electrical isolation (R_i) according to the following formula:

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

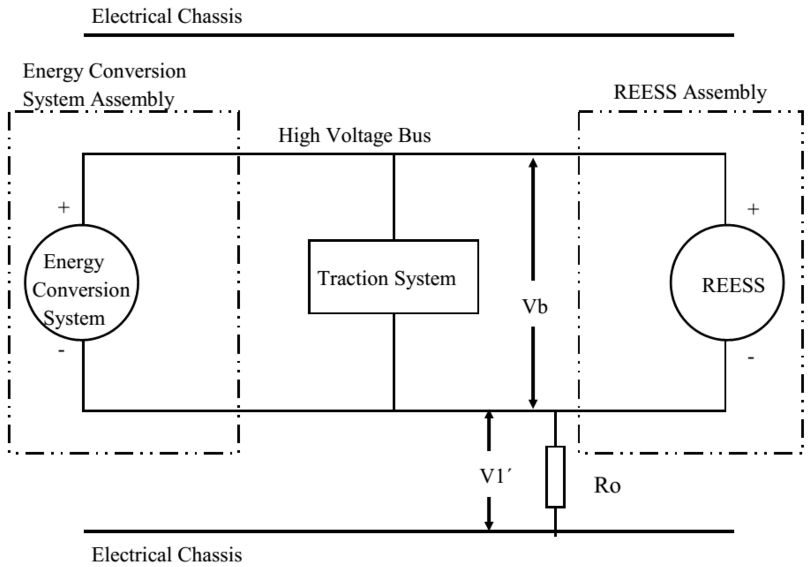


Figure-2
Measurement of V_1'

If V2 is greater than V1, insert a standard known resistance (Ro) between the positive side of the high voltage bus and the electrical chassis. With Ro installed, measure the voltage (V2') between the positive side of the high voltage bus and the electrical chassis (see Figure 3). Calculate the electrical isolation (Ri) according to the formula shown. Divide this electrical isolation value (in Ω) by the nominal operating voltage of the high voltage bus (in volts).

Calculate the electrical isolation (Ri) according to the following formula:

$Ri = Ro*(V_b/V_2' – V_b/V_2)$ or $Ri = Ro*V_b*(1/V_2' – 1/V_2)$

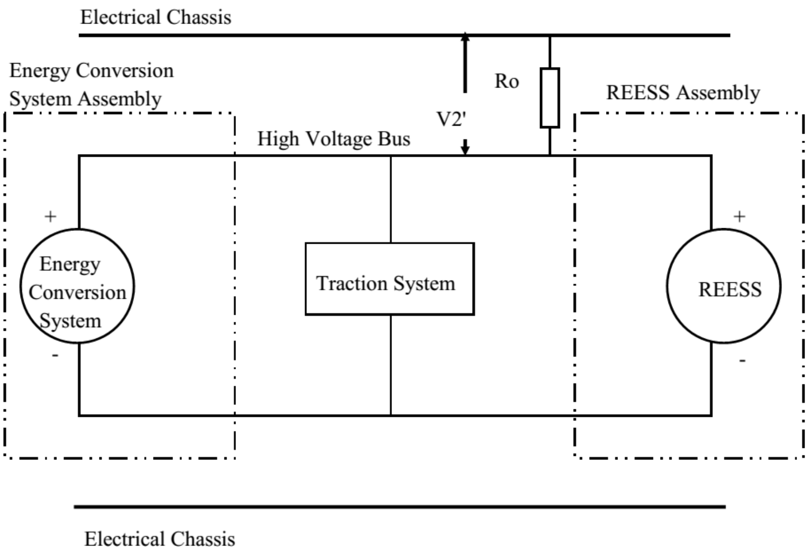


Figure-3
Measurement of V_2 ’

2.2.3.5 Fifth Step

The electrical isolation value Ri (in Ω) divided by the working voltage of the high voltage bus (in volts) results in the isolation resistance (in Ω/V).

Note: The standard known resistance Ro (in Ω) should be the value of the minimum required isolation resistance (in Ω/V) multiplied by the working voltage of the vehicle plus/minus 20 per cent (in volts). Ro is not required to be precisely this value since the equations are valid for any Ro; however, a Ro value in this range should provide good resolution for the voltage measurements.

ANNEX C

(See 3.1.3.3)

CONFIRMATION METHOD FOR FUNCTION OF ON-BOARD ISOLATION RESISTANCE MONITORING SYSTEM

The function of the on-board isolation resistance monitoring system shall be confirmed by the following method:

Insert a resistor that does not cause the isolation resistance between the terminal being monitored and the electrical chassis to drop below the minimum required isolation resistance value. The warning shall be activated.

ANNEX – D

(See 3.5.1)

HOSE NOZZLE FOR THE TEST FOR PROTECTION AGAINST WASHING

This Annex specifies dimensionally the hose nozzle to be used for IPX5 test procedure as specified in IEC 60529 (All dimensions are in mm).

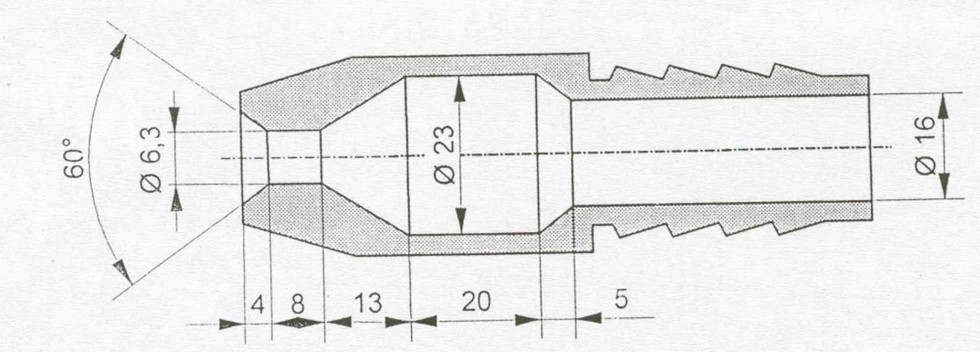


Figure A.1 - Hose nozzle dimensions

ANNEX E

(See Introduction)

COMPOSITION OF AISC PANEL ON ELECTRIC POWER TRAIN VEHICLES- CONSTRUCTION AND FUNCTIONAL SAFETY REQUIREMENTS*

Convener	
Mr. A.A. Deshpande	The Automotive Research Association of India (ARAI)
Members	**Representing**
Mr. M. M. Desai	The Automotive Research Association of India (ARAI)
Mr. D. P. Saste/ Mr. Karthikeyan K (Alternate)	Central Institute of Road Transport (CIRT)
Representative from	International Centre for Automotive Technology (ICAT)
Mr. Vinod Kumar	Vehicle Research & Dev. Estt. (VRDE)
Dr. N. Karuppaiah	National Automotive Testing and R&D Infrastructure Project (NATRIP)
Mr. K. K. Gandhi	Society of Indian Automobile Manufacturers (SIAM)
Mr. T. M. Balaraman	Society of Indian Automobile Manufacturers (SIAM) (Hero Moto Corp Ltd.)
Mr. Adish Agrawal	Society of Indian Automobile Manufacturers (SIAM) (Hero Moto Corp Ltd.)
Mr. Rajendra Khile	Society of Indian Automobile Manufacturers (SIAM) (General Motors)
Mr. Kiran Mulki	Society of Indian Automobile Manufacturers (SIAM) (Mahindra and Mahindra)
Mr. K. Kiran Kumar	Society of Indian Automobile Manufacturers (SIAM) (Mahindra Reva)
Mr. Vijeth R Gatty	Society of Indian Automobile Manufacturers (SIAM) (Toyota Kirloskar Motors Ltd.)
Mr. Firoz Khan	Society of Indian Automobile Manufacturers (SIAM) (Tata Motors Ltd.)
Mr. Vivekraj S	Society of Indian Automobile Manufacturers (SIAM) (Renault Nissan)
Mr. P. C. Joshi	Bureau of Indian Standards (BIS)

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

ANNEX F

(See Introduction)

COMMITTEE COMPOSITION *

Automotive Industry Standards Committee

Chairperson	
Mrs. Rashmi Urdhwareshe	Director The Automotive Research Association of India, Pune
Members	**Representing**
Representative from	Ministry of Road Transport and Highways (Dept. of Road Transport and Highways), New Delhi
Representative from	Ministry of Heavy Industries and Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri Shrikant R. Marathe	Former Chairman, AISC
Shri N. K. Sharma	Bureau of Indian Standards, New Delhi
Director/ Shri D. P. Saste (Alternate)	Central Institute of Road Transport, Pune
Director	Indian Institute of Petroleum, Dehra Dun
Director	Vehicles Research and Development Establishment, Ahmednagar
Representatives from	Society of Indian Automobile Manufacturers
Shri T. C. Gopalan	Tractor Manufacturers Association, Chennai
Shri Uday Harite	Automotive Components Manufacturers Association of India, New Delhi

Member Secretary

Mr. A. S. Bhale

General Manager

The Automotive Research Association of India, Pune

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