भारतीय मानक
Indian Standard

IS 18294 : 2023

इलेक्ट्रिक रिक्शा/ई-कार्ट — निर्माण कार्यात्मक सुरक्षा आवश्यकताएँ — विशिष्ट

Electric Rickshaw/E-Kart — Construction and Functional Safety Requirements — Specification

ICS 43.120

भारतीय मानक ब्यूरो
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Electric and Hybrid Vehicles Sectional Committee, TED 27

FOREWORD

This Indian Standard was adopted by Bureau of Indian Standards, after the draft finalized by the Electric and Hybrid Vehicles Sectional Committee is approved by the Transport Engineering Division Council.

Electric rickshaws (also known as e-rickshaws) are 3 wheelers pulled by an electric motor and powered by a battery. They are becoming very popular in many cities since 2008 as an alternative to pulled rickshaw because of their low fuel cost, last mile connectivity and less human effort compared to cycle rickshaws. They are also being widely accepted as an alternative to auto rickshaws for short distances commute.

In the formulation of this standard, considerable assistance has been derived from:

a) GSR (709) E dated 08th October 2014 of Ministry of Road Transport and Highways;
b) *Central Motor Vehicle Rules*, 1989 (CMVR); and
c) AIS 049 battery operated vehicles — CMVR type approval for battery operated vehicles.

The composition of the Committee responsible for the formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of test or analysis, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ELECTRIC RICKSHAW/E-KART — CONSTRUCTION AND FUNCTIONAL SAFETY REQUIREMENTS — SPECIFICATION

1 SCOPE

This standard specifies requirements for the construction and functional safety of E-Rickshaw and E-Kart .

2 REFERENCES

The standards given below contain provisions, which through reference in this text, constitute provisions of the standards. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of these standards:

IS No./Other publication	*Title*
IS 1293 : 2019	Plugs and socket — Outlets of rated voltage up to and including 250 volts and rated current up to and including 16 amperes — Specification (*fourth revision*)
IS/IEC 60309-2 : 2002	Plugs, socket-outlets and couplers for industrial purposes: Part 2 Dimensional interchangeability requirements for pin and contact tube accessories (*first revision*)
IS/IEC 60529 : 2001	Degrees of protection provided by enclosures IP CODE
AIS 049 Rev 1 : 2016	Electric power train vehicles — CMVR type approval for electric power train vehicles

3 VEHICLE CONSTRUCTION REQUIREMENTS AND TEST PROCEDURE

3.1 Traction Battery

3.1.1 Installation of the traction battery in the vehicle shall not allow any potential dangerous accumulation of gases. Details of the ventilation provided by manufacturer shall be verified by test agency at the time of type approval.

3.1.2 Battery compartments containing battery modules, which may produce hazardous gases shall be safely ventilated. Details of ventilation provided by manufacturer shall be verified by the test agency at the time of type approval.

3.1.3 The traction battery and the power train shall be protected by properly rated fuse or circuit breakers. The components on the vehicle shall be as per the specifications declared by the manufacturer. The same shall be verified by the test certifying agency at the time of type approval.

3.1.4 *Mounting of Batteries*

The mounting of batteries in the battery-operated vehicle shall be such that batteries/battery packs are not displaced from their place and there is no spillage of electrolyte when vehicle is driven on gradient or any other type of road. This condition shall be deemed to be satisfied if no spillage of electrolyte is observed while conducting various tests for type approval.

3.1.5 *Creepage Distance measurement for Traction Batteries*

This clause deals with additional leakage current hazard between the connection terminals of a traction battery 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 for example, 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 = creepage distance measured on the tested traction battery in mm; and

U = 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 = creepage distance measured between the live part and the electrical chassis in mm; and

U = nominal voltage between the two battery connection terminals in V.

3.2 Protection Against Electric Shock

3.2.1 *Protection Against Direct Contact with Live Parts of the Power Train*

3.2.1.1 Direct contact with live parts of the electrical power train whose maximum voltage is at least 60 V d.c. or 30 V a.c. (rms) shall be prevented either by insulation or by the use of covers, protection grills, perforated metal sheets, etc. These protections shall be reliably secured and shall be mechanically resistant. They shall not be able to be opened, dissembled or removed without the use of tools.

3.2.1.2 Live parts in passenger and load compartments, shall be protected by enclosures having a protection degree of at least IPXXD.

3.2.1.3 Enclosures in other areas of the vehicle shall have a protection degree of at least IPXXB

3.2.1.4 In the drive train compartment the access to live parts shall only be possible with voluntary action that is, with the use of physical tools like screw driver to open the same.

3.2.1.5 After opening the cover, the access to the parts of the coupling system shall be protected with IPXXB protection.

3.2.1.6 Protection degrees IPXXB and IPXXD are related respectively to the contact of a jointed test finger and a test wire with hazardous parts. Please *see* Annex A for the test procedure.

3.2.1.7 *Vehicle markings*

Protection covers of live parts described in **3.2.1.1** shall be marked by a symbol as follows:

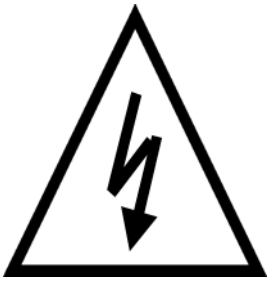


FIG.1 SYMBOL FOR THE INDICATION OF A VOLTAGE BLACK ON A YELLOW GROUND

3.2.2 *Protection Against Indirect Contact with Exposed Conductive Parts of the Power Train*

3.2.2.1 If the working voltage of the electric circuit is lower than 60 V d.c. or 30 V a.c. (rms), no requirements are necessary.

3.2.2.2 The design, installation and manufacture of electric material shall be such that insulation failures are avoided. This shall be considered as a design guideline.

Insulation used shall ensure protection against indirect contacts and additionally, the exposed conductive parts of the on-board equipment shall be electrically connected together. This potential equalization is obtained by connecting the exposed conductive parts together either by a protective conductor for example, wire, ground truss, or directly by the vehicle metallic chassis. Two exposed conductive parts welded together are considered as having no discontinuity points. If there is some discontinuity, this point shall be by-passed by potential equalization.

NOTE — If the working voltage of the electric circuit is lower than 60 V d.c. or 30 V a.c. (rms), requirements specified in **3.2.1** are not applicable.

3.2.3 *Insulation Resistance of Traction Batteries*

3.2.3.1 Using a measuring DC voltage equal to the nominal voltage of the traction battery, insulation resistances between any exposed conductive part and each polarity of the traction battery shall have a minimum value of 500 Ω/V of the nominal voltage (*see* Annex B).

3.2.2.2 *Resistance of the protective conductor*

The potential equalization resistance between any two exposed conductive parts shall be lower than 0.1 Ω. This test shall be performed by a current of at least 0.2 A.

3.2.4 *Connection of the Vehicle to the Mains Network*

3.2.4.1 In no case the vehicle shall be capable to move by its own means when it is electrically connected to an energy supply network or to an off-board charger.

3.2.4.2 The components used when charging the battery from an external source shall allow the charging current to be cut without physical damage in case of disconnection. This shall be checked by reconnection and ensuring that there is no fault in the system.

3.2.4.3 The coupling system parts likely to be live shall be protected against any direct contact in all operating conditions.

3.2.4.4 For on-board charger all exposed conductive parts, shall be electrically linked through a conducting wire plugged to earth when charging.

3.3 Functional Safety Requirements

3.3.1 *Power ON Procedure*

The power ON procedure shall be applied via a key switch. It shall not be possible to remove this key in any position that energises the drive train or that makes active driving possible

3.3.2 *Running and Stopping Conditions*

3.3.2.1 At least a momentary, optical or audible indication shall be given to the driver when:

a) the vehicle is in 'active driving possible mode'; or

b) At least one further action is required to place the vehicle in 'active driving possible mode'.

There shall also be an indication to the driver when state of charge of the battery reaches a level where re-charging is recommended. When this condition is reached, the user shall be warned to perceive this situation quickly enough to be able to drive the vehicle, on its own power, at least out of the traffic zone. The manufacturers shall provide the information regarding the state of charge after the warning indication comes on.

There shall be an additional indication indicating that the state of charge of battery has reached a level at which driving the vehicle further may cause damage to the battery. This indication is not necessary if the emergency power reduction (**3.3.4**) takes into account this state of charge of battery. This shall be declared by the manufacturer.

3.3.2.2 Unintentional acceleration, deceleration and reversal of the drive train shall be prevented. In particular, a failure (for example, in the power train) shall not cause more than 0.1 m movement of a standing un-braked vehicle on level road.

3.3.2.3 When leaving the vehicle, the driver shall be informed by an optical or audible signal if the drive train is still in the active driving possible mode. This condition shall be deemed to be satisfied if the indication specified in **3.3.2.1** (a) is not momentary and continues to be displayed.

3.3.3 *Reversing* (*in Line with CMVR Rule* 99)

3.3.3.1 Reversing shall be possible only after a specific action. This action shall require either:

a) The combination of two different actuations; or

b) An electric switch, which allows reverse to be engaged only when the vehicle is moving at a forward speed not exceeding 5 km/h. It shall not be possible for the vehicle to move in reverse direction, if the switch is operated when vehicle is moving forward at a speed beyond 5 km/h. The device shall have only one stable position for achieving the reverse motion of the vehicle. The state of the drive direction control unit shall be easily identifiable. The maximum speed achieved in reverse direction shall not be more than 20 km/h.

3.3.4 *Emergency Power Reduction*

3.3.4.1 If the vehicle is equipped with a device to limit the performance in an emergency (for example, overheating of a component) the user shall be informed by an obvious signal indicating state of limited performance.

3.4 On-board Charger

The charger socket of the on-board charger shall have the time rating in addition to the ampere rating. The time rating shall be 5 h or the recommended time for charging fully discharged battery, whichever is higher. The charging socket shall be capable of withstanding the in-rush current and the continuous current rating of the socket shall be commensurate with the charging current.

The rated maximum and continuous duty specification of the power socket in terms of current, voltage etc. shall be declared by the manufacturer. These values shall be compatible with the specification of the onboard charger. The manufacturer shall certify compliance to these parameters. The mains plug shall be compatible for use with sockets as per IS 1293 or IS/IEC 60309-2 or any equivalent.

On-board charger shall have soft start facility, limiting the initial in-rush current. The manufacturer shall specify the initial rush current and the time duration from the mains to the charger.

The charger shall have at least indication of 'charging in process' and 'charging is over'. These conditions are deemed to be satisfied if the indicator for state of charge of battery provided on vehicle takes care of this requirement.

3.5 On-board Indicators

3.5.1 All the indicators meant for the driver referred above shall be suitably located so as to be visible to the driver easily (for example, on the dashboard).

3.5.2 Additionally, the battery-operated vehicle shall have the battery state of charge indicator. For additional indications of temperatures like motor temperature, the existing water temperature symbol may be suitably modified.

3.6 Protection Against Water Effects

The tests as per **3.6.1**, **3.6.2** and **3.6.3** shall be performed. After each exposure (vehicles still wet), the vehicle shall then comply with the insulation resistance test as in **3.2.3.2**, at normal environmental condition, but keeping the power equipment connected to the traction battery (main switch closed), with the requirements of at least 100 Ω/V.

3.6.1 *Washing*

This test is intended to simulate a normal washing of battery-operated 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 that is, 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 IS/IEC 60529 and shown in Fig. 2.

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.

3.6.2 *Flooding*

This test is intended to simulate the driving of a battery-operated vehicle 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.

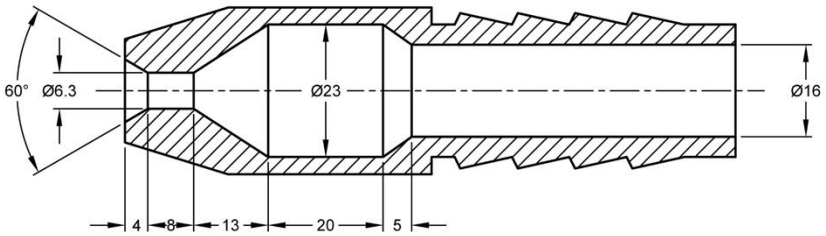
If the wade pool used is less than 500 m in length, so that it has to be driven through several times, the total time including the periods outside the wade pool shall be less than 10 min.

3.6.3 *Heavy Rainstorm*

This test is intended to simulate a sudden heavy rainstorm for example, 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.



All dimensions in millimeters

FIG. 2 HOSE NOZZLE

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 following nominal voltage (U):

a) d.c.: 60 V < U <= 1 500 V

b) a.c.: 25 V rms < U < = 1 000 Vrms – 15 Hz to 150 Hz

4 TECHNICAL SPECIFICATIONS

The details of technical specification, approvals of changes in specification shall be as per **5.0** and **6.0** of AIS-049 Rev 1.

ANNEX A

(*Clause* 3.2.1.6)

PROTECTION AGAINST DIRECT CONTACTS OF PARTS UNDER VOLTAGE

A-1 PROTECTION PROVIDED BY AN ENCLOSURE AGAINST ACCESS TO HAZARDOUS PARTS

The protection of persons shall be given against:

a) Contact with hazardous low-voltage live parts;
b) Contact with hazardous mechanical parts; and
c) Approach to hazardous high-voltage live parts below adequate clearance inside an enclosure.

NOTE — This protection may be provided:
a) By means of the enclosure itself; and
b) By means of barriers as part of the enclosure or distances inside the enclosure.

A-2 TEST FOR PROTECTION AGAINST ACCESS TO HAZARDOUS PARTS

A-2.1 Access Probes

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

A-2.2 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 stop face fully penetrate through the opening.

Internal barriers are considered part of the enclosure as given in the definition.

For tests on low-voltage equipment, a low voltage supply (or not less than 40 V and not more than 50 V) in series with a suitable lamp shall be connected between the probe and the hazardous parts inside the enclosure. Hazardous live parts covered only with varnish or paint, or protected by oxidation or by a similar process, are covered by metal foil electrically connected to those parts, which are normally live in operation.

The signal circuit method shall also be applied to the hazardous moving parts of a high voltage equipment. Internal moving parts may be operated slowly, where this is possible.

A-2.3 Acceptance Conditions

The protection is satisfactory adequate clearance is kept between the access probe and hazardous parts.

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

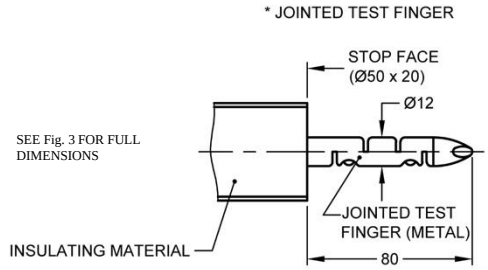
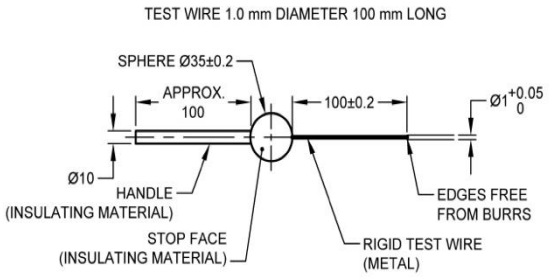
In case of the tests for the additional letter D, the access probe may penetrate to its full length, but the stop face shall not fully penetrate through the opening.

Conditions for verification of adequate clearance are identical with those given in **2.3.1.**

A-2.3.1 For low voltage equipment (rated voltages not exceeding 1 000 V a.c. and 1 500 V d.c.). The access probe shall not touch hazardous live parts. If adequate clearance is verified by a signal circuit between the probe and hazardous parts, the lamp shall not light.

Table 1 Access Probes for the Tests for Protection of Persons

(*clauses* 2.1 *and* 2.2)

B		**10 N ± 10 %**
D		**1 N ± 10 %**

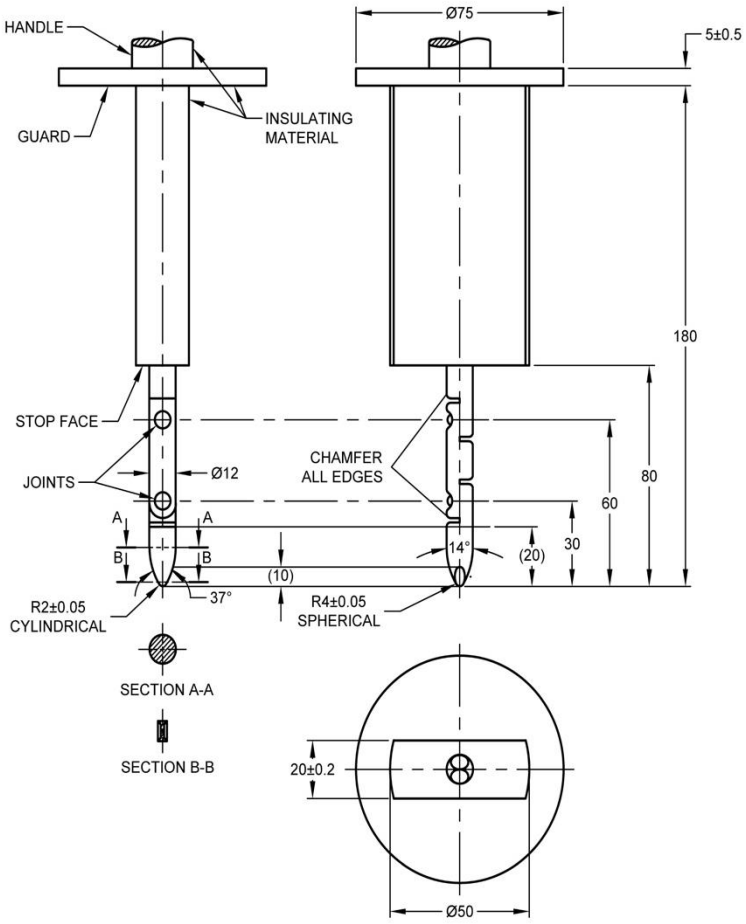


FIG. 3 JOINTED TEST FINGER

ANNEX B

(*Clause* 3.2.3.1)

MEASUREMENT OF THE INSULATION RESISTANCE USING THETRACTION BATTERY

B-1 DESCRIPTION OF THE TEST METHOD

B-1.1 The traction battery shall be fully charged.

B-1.2 The voltmeter used in this test shall measure DC values and have an internal resistance greater than 10 Mohm.

B-1.3 Measurement shall be made in two steps:

B-1.3.1 *Step One*

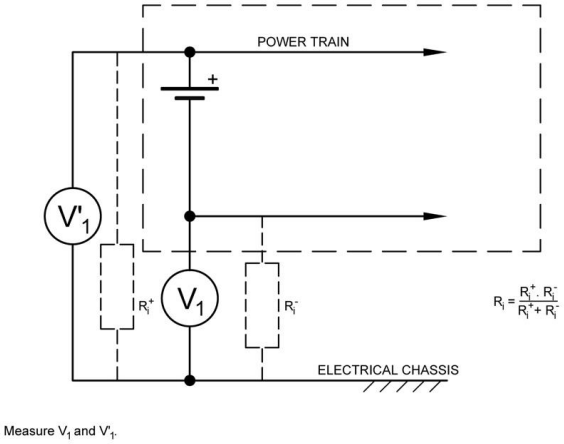
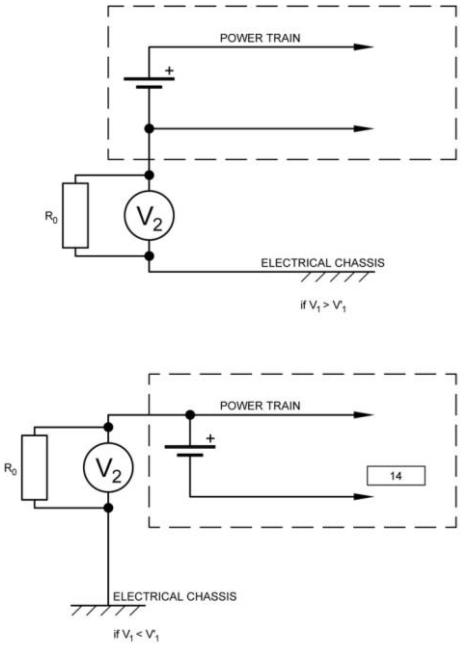


FIG. 4 MEASUREMENT OF INSULATION RESISTANCE STEP ONE

B-1.3.2 *Step Two*



where Ro is a resistance of 500 Ω/V

FIG. 5 MEASUREMENT OF INSULATION RESISTANCE STEP TWO

The value of the insulation resistance R_i is given by one of the following formula:

$$R_i = \frac{V_1 - V_2}{V_2} \times R_0 \text{ or } R_i = \frac{V_1' - V_2}{V_2} \times R_O$$

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

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Review of Indian Standards

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Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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