AMENDMENT NO. 2 10 April 2015

TO

AIS-049:2003

Battery Operated Vehicles - CMVR Type Approval for Battery Operated Vehicles

1. **Page No. 27, Annex E, clause E 1.38 (ii).**

Substitute following text for the existing text:

"E1.38 (ii) Three wheeled vehicles**,** M1 and L7 category vehicles: unladen mass increased by a figure of 150 kg."

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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 VEHICLES RULES - TECHNICAL STANDING COMMITTEE

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

10 April 2015

AMENDMENT NO. 1

TO

AIS-049
Battery Operated Vehicles –
CMVR Type Approval for Battery Operated Vehicles

1.0 Page No. 27, Annex E, clause E 1.38 : Reference Mass

Substitute following text for the existing text:

"**E 1.38** "**Reference Mass**" means

i) Two wheeled vehicles: unladen mass increased by a figure of 75 kg
ii) Three wheeled vehicles and M1 category vehicles: unladen mass increased by a figure of 150 kg
iii) N1 category vehicles: unladen mass increased by a figure of 50% of the pay load".

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GOVERNMENT OF INDIA

March 2011

AIS-049

AUTOMOTIVE INDUSTRY STANDARDS

Battery Operated Vehicles - CMVR Type Approval for Battery Operated Vehicles

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

September 2003

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

Sr.	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 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 document on their website.

This Standard prescribes the applicability of CMVR rules and corresponding Standards for battery operated vehicles.

The Committee responsible for preparation of this standard is given in Annexure- G.

CMVR Type Approval for Battery Operated Vehicles

1. APPLICABILITY OF THE RULES PRESCRIBED IN CENTRAL MOTOR VEHICLES (AMENDMENT) RULES, 1989 (CMVR)

1.1 The following rules are not applicable for battery operated vehicles

Rule No.	Subject
112	Exhaust gases
113	Location of Exhaust Pipes.
114	Exhaust pipes of public service vehicles.
116	Test for smoke emission level and carbon monoxide level for motor vehicles
115, (A), (B)	Emission of smoke, vapour, etc. from motor vehicle.
120(1)	Fitment of Silencer

1.2 The following rules are applicable, after taking into consideration the amendments listed in Annex A.

Rule No.	Subject
2	Definition
96(4)	Brakes
101 (1)	Power operated windscreen Wiper
101 (3)	Hand operated wind screen wiper
102	Signaling devices, direction indicators and stop lights.
103	Position of the indicator.
104	Fitment of reflectors.
105	Lamps
109	Parking light
110	Lamp on auto-rickshaw and three-wheelers with engine capacity not exceeding 500 cc.
120 (2)	Sound level
122	The title to be changed to “Embossment of the Chassis number and Engine number or motor number in the case of battery operated vehicles and date of manufacture
125(1)	Safety-belt, Collapsible steering column, auto-dipper and padded dashboards

1.3 All other rules of CMVR shall be applicable as detailed in each rule.

2.0 APPLICABILITY OF STANDARDS NOTIFIED UNDER RULE 124

2.1 The following standards are not applicable to battery-operated vehicles

Standard No.	Subject
IS:12056:1987, AIS-033/2001 and IS 14681: 1999	Fuel Tanks
IS 14283: 1995	The accelerator control system
IS 10791: 1983	Control Cables
IS 13942: 1994	External Projection for three wheeled Battery Operated Vehicles
Note: The requirements of control cables and external projections will become applicable to battery-operated vehicles as and when they become applicable for IC engined vehicles.	

2.2 Gradeability test (AIS-003)

This test would be conducted once, for battery operated vehicles at 60 % state-of-discharge condition of the battery.
The gradeability requirements of 7 degrees shall be applicable to all two wheeled battery operated vehicles also.

2.3 All other notified standards shall be applicable as detailed in the notification.

3.0 STANDARDS REFERRED TO IN VARIOUS RULES OF CMVR

3.1 Brake performance:

The changes needed in the test procedure (IS 14664 and IS 11852 as applicable) for evaluating the prescribed performance requirements of braking systems for battery operated vehicles, to take into account regenerative braking system, are given in Annex B.

Note: *Certain amendments to IS 14464 have been agreed in the AISC for incorporating the requirements of three wheelers with GVW between 1 and 1.5 T. These are given in Annex C, which shall be taken into account for compliance requirements.*

3.2 Measurement of pass by noise level:

In IS 3028, the approach speed is specified in terms of the engine rpm in certain cases of vehicles. In case of battery operated vehicles the following are the applicable approach speeds:

3.2.1 50km/h or 75% of the maximum design speed of the vehicle which ever is lower, in the following types of vehicles

a) Two wheelers with maximum design speed exceeding 45km/hr, with manual shift gearbox (Para 8.2.1 of IS 3028:1998.)

b) Three wheelers with manual shift gearbox (Para 8.3 a) of IS 3028:1998).

c) Four wheeled and multi axles vehicles with manual gearbox or an automatic transmission with a manual over ride. (Para 8.4.1 of IS 3028:1998.). Condition given in Para 8.4.2 shall apply.

3.2.2 In all other cases the approach speed shall be same as prescribed in IS 3028:1998.

3.3 **EMI Test**

The AIS 004-1999 Standard 'Electromagnetic Radiation from Automotive Vehicle – Permissible Levels and Methods of Tests' has been prepared in line with ECE regulations. The same Standard will be adopted for battery operated vehicles with amendments given in Annexure-D.

4.0 DEFINITIONS

Definitions for battery operated vehicle are enclosed in Annexure-E.

5.0 TECHNICAL SPECIFICATIONS:

The information to be submitted by the manufacturer for type approval shall contain the information given in the revised version of AIS-007.

Note: The requirements specific to battery operated vehicles are given in Table 13 of AIS-007

6.3 If the changes are in parameters related to the provisions, the testing agency may then consider, whether,

a) The model with the changed specifications still complies with the provisions; or

b) Any further verification is required to establish compliance.

6.4 For considering any further verification is required or not the guidelines given in **Annex F** may be used.

6.5 In case of **6.3b),** verification for only those parameters, which are affected by the modifications need to be carried out.

6.6 In case of fulfillment of criterion of para **6.3 a)** or after results of further verification as per para **6.3b)** are successful, the approval of compliance shall be extended for changes carried out.

7.0 VALIDITY OF ANNEXES

It is expected that in due course of time the details given in Annexs A, to D would be incorporated in CMVR and other related documents referred in this chapter. Once such an incorporation takes place, the details given in these annexes would be automatically defunct.

Annex : A

Changes in CMVR consequential to AIS 008, 009, 030, rationalization of three wheelers and battery operated vehicles suggested vide letter no. PE/tmb/drftnoti/ais8, 9, bov, ratz dated 17th May 2002

(Taking into account changes as per GSR 400(E))

Sl. No.	Amendment required in CMVR
A1	In Rule No. 2 after the para (ca) the following para shall be inserted namely: "*'Battery Operated Vehicle' means a vehicle intended for road use, powered exclusively by an electric motor whose traction energy is supplied exclusively by traction battery installed in the vehicle."*
A2	On and from six months from the date of notification of these rules, in the Sub-rule (4) of Rule 96, a) For sub-para (i), the following shall be substituted, namely: "*For motor cycles IS 14664:1999*" b) For sub-para (ii), the following shall be substituted, namely: *"For three wheelers IS 14664:1999"* In sub-para (ii) the words "*three wheelers with a gross vehicle weight not exceeding 1000 kgs; and"* shall be deleted.
A3	On and from six months from the date of notification of these rules, in sub-rule 1 of Rule 101, for the words and figures "*motor cycles, and three wheelers of engine capacity not exceeding 500cc*" the words "*and motor cycles*" shall be substituted.
A4	On and from six months from the date of notification of these rules, sub-rule 3 of Rule 101 shall be deleted.
A5	On and from six months from the date of notification of these rules, for Sub-rule (1) of Rule 102 and the proviso thereunder, the following sub-rule and proviso shall be substituted namely:

"The signal to turn to the right or to the left shall be given by electrically operated direction indicator lamps on all motor vehicles including construction equipment vehicles.

Every construction equipment vehicle shall be fitted and maintained such that the following conditions are met, namely:

i) the direction indicator lamps shall be of amber colour which are illuminated to indicate the intention to turn, by a light flashing at the rate of not less than 60 and not more than 120 flashes per minute.

ii) the light emitted by the lamp when in operation shall be clearly visible from both front and rear of the vehicle.

iii) the minimum illuminated area of each direction indicator shall be 60 square centimeters.

Provided that nothing contained in this sub-rule shall apply to motor cycles of engine capacity exceeding 70cc manufactured before 1.6.1990 and to motor cycles of engine capacity not exceeding 70 cc manufactured before 1.1.2003 and to L1 category of motorcycles.

A6 On and from six months from the date of notification of these rules, in Sub-rule (2) of Rule 103, for the words and figures "*three wheelers of engine capacity not exceeding 500cc*" *the words* "*three wheelers for carrying passengers*" shall be substituted."

A7 On and from six months from the date of notification of these rules, for Sub-rule (1) of Rule 104, the following shall be substituted namely:-

"*Every motor vehicle including trailers and semi-trailers, other than three wheelers and motor cycles shall be fitted with two red reflectors, one each on both sides at the rear. Every motor cycle shall be fitted with at least one red reflex reflector at the rear.*"

The provision remains unaltered.

On and from six months from the date of notification of these rules, in Sub-rule (2) of Rule 104, the words and figures "*engine capacity not exceeding 500cc*" shall be deleted.

A8 On and from six months from the date of notification of these rules, for Sub-rule (3) of Rule 104, the following sub-rule shall be substituted namely:

"All trailers including semi-trailers, other than those drawn by three wheeled tractors shall be fitted with the following reflex reflectors, namely:

i) two white reflectors in the front one each at the right and left corners

ii) two red reflex reflectors at the rear, one each at the right and left corners."

A9 On and from six months from the date of notification of these rules, for Sub-rule (5) of Rule 104, the following sub-rule shall be substituted namely:

"*Every motor vehicle and trailer of length exceeding 6 meters shall be fitted with at least one side retro-reflector must be fitted to the middle third of the vehicle, the foremost side retro-reflector being-not further than 3 m from the front; in the case of trailers, account shall be taken of the length of the draw bar for the measurement of this distance. The distance between two adjacent side retro-reflectors shall not exceed 3 m. The colour of the reflector shall be amber.*

The rear most side reflector can be red, if it is grouped or has part of the light emitting surface in common with rear position lamps."

The proviso shall be deleted.

A10 On and from six months from the date of notification of these rules, for Sub-rule (1), its sub-paras (a), (b) and (c) of Rule 105, the following sub-rule shall be substituted namely:

"*Save as hereinafter provided, every motor vehicle, while being driven in a public place, during the period half an hour after sunset and at any time where there is not sufficient light, shall be lit with the following lamps:*"

(a) "save in the case of three wheelers, three wheeled invalid carriages, motor cycles, and construction equipment vehicles, two or four head lamps.
(b) in the case of motor cycles and three wheeled invalid carriages one or two headlamps
(c) in the case of a side car attached to a motorcycle one lamp showing a white light to the front.

A11 On and from six months from the date of notification of these rules, for sub-rule (2) of Rule 105 the following sub-rule shall be substituted namely:

"Every motor vehicle other than a three wheeler and motor cycle, shall carry:

i) two rear lamps showing to the rear a red light and every motor cycle shall carry one lamp showing to the rear a red light

ii) *a lamp illuminating with a white light the registration mark exhibited at the rear of the vehicle and on the side incase of construction equipment vehicle.*"

The provisos remain unaltered.

A12 On and from six months from the date of notification of these rules, the Sub-rule (3) of Rule 105, and the provisos thereunder shall be deleted.

A13 On and from six months from the date of notification of these rules, for Sub-rule (4) of Rule 105 and the proviso thereunder shall be deleted.

A14 On and from six months from the date of notification of these rules, 105 (6) shall be deleted, and in the proviso, the words "*provided that*" shall be deleted.

A15 On and from six months from the date of notification of these rules, in Rule 109, the words and figures "*three wheelers of engine capacity not exceeding 500cc*" shall be deleted.

A16 On and from six months from the date of notification of these rules, in Rule 110,

a) The title shall be substituted by the following, *viz.:* "*Lamps on three wheelers.*"

b) The words and figures *"autorickshaw and three wheeler of engine capacity not exceeding 500cc" the words "three wheeler*" shall be substituted

c) The following proviso shall be inserted namely:

"*Provided further that fitment of only one head lamp is applicable only in case of three wheelers with overall width not exceeding 1400mm and in such cases the side lights shall be amber in colour.*

The existing proviso remains unaltered.

A17 In sub-rule (2) of Rule 120 the following proviso shall be inserted namely:

"*Provided that where different noise levels are prescribed for petrol and diesel vehicles, the limits prescribed for the petrol vehicle of the same category shall apply to battery operated vehicles*"

A18 For the title of Rule 122,

a) The following title shall be substituted namely:

"*Embossment of the Chassis number and Engine number or motor number in the case of battery operated vehicles and date of manufacture"*

b) For the words *"engine number, chassis number and month of manufacture all together,"* appearing in the proviso the words *"engine number/motor number, chassis number and month of manufacture all together,"* shall be substituted.

A19 In sub rule (1) of Rule 125, for the words and figures "*of engine capacity not exceeding 500cc*," shall be deleted.

A20 Applicable forms: In various forms prescribed under CMVR, wherever the term "*Engine number*" appears, to be changed to "*engine number or motor number in the case of battery operated vehicles*"

Annex : B (See para 3.1)
Requirements of Brake and Braking Systems for Electric Vehicles

B1.0 Definitions:

B1.1 "Electric regenerative braking system" means a braking system, which allows the use of the vehicle's drive motor(s) to convert the kinetic energy of the vehicle into electrical energy during deceleration.

B1.2 "Electric regenerative brake control" means a device which modulates the action of the electric regenerative braking system

B1.3 "Electric regenerative braking system of Category A" means an electric regenerative braking system, which is not part of the service braking system.

B1.4 "Electric regenerative braking system of Category B" means an electric regenerative braking system, which is part of the service braking system.

B2.0 General requirements of electric regenerative braking systems:

A battery operated vehicle, if fitted with an electric regenerative braking system, shall comply with the following requirements:

B2.1 Vehicles fitted with Electric regenerative braking system of Category A:

The electric regenerative braking shall be only activated by accelerator control and/or the gear neutral position.

B2.2 Vehicles fitted with Electric regenerative braking system of Category B:

B2.2.1 It shall not be possible to disconnect partially or totally one part of the service braking system other than by an automatic device

B2.2.2 The service braking system control shall also actuate the action of the electric regenerative braking system simultaneously.

B2.2.3 The service braking system shall not be adversely affected by the disengagement of the motor(s) or gear ratio used, except during the short duration of operation of gear shifting.

B3.0 Requirements of two wheelers:

B3.1 The requirements covered in IS 14664:1999 shall be complied with.

B3.2 If the brake control (front or rear or both) actuates the electric regenerative brake system (Category B), the prescribed performance requirements shall be complied with the use of the electric regenerative system.

The performance requirements may be verified without the use of the electric regenerative system if so desired by the manufacturer.

B3.3 If the brake control (front or rear or both) does not actuate the electric regenerative brake system (Category A) the prescribed performance requirements shall be obtained without the use of the electric regenerative system.

B4.0 Requirements of three wheelers:

B4.1 The requirements covered in IS 14664:1999 shall be complied with.

B4.2 In the case of three wheelers with GVW not exceeding 1 ton (Category1 & 2 as defined in IS 14664:1999) the conditions of regenerative braking system shall be same as those given in para B3.2 and B3.3

B4.3 For three wheelers with GVW exceeding 1 ton (Category 3 as defined in IS 14664:1999) the conditions of regenerative braking system shall be same as those given in para B5.2. and B5.3.

B4.4 For the purpose of classification only, GVW shall be considered ignoring the weight of the traction batteries. The tests shall be conducted with the full GVW, i.e. including the weight of the traction batteries also.

B5.0 Requirements of vehicles with more than three wheels:

B5.1 The requirements given in the applicable parts of IS:11852 shall be complied with.

B5.2 If the service brake control actuates the electric regenerative brake system (Category B) the prescribed performance requirements shall be obtained with the electric regenerative system.

B5.2.1. The specified secondary brake prescribed performance requirements shall be met with the failure of the regenerative braking simulated without any other failure in the service brake system.

B5.3 If the service brake control does not actuate the electric regenerative brake system(Category A) the prescribed performance requirements shall be obtained without the use of the electric regenerative system.

Annex : C

Proposed Amendments to IS 14464: 1999 for Braking System to incorporate the Features for 3 Wheelers of 1 to 1.5T GVW

C1 Para 1.1 Page 1:

Substitute "*of all types of two and three wheeled motor vehicles*" for the words "of all types of two wheeled motor vehicles and three wheeled motor vehicles whose maximum gross vehicle weight does not exceed 1500kg"

C2 Para 4.2 Page 2:

a) In para b) add the following words at the end: "*and the gross vehicle weight not exceeding 1 tonne*."

b) Add the following: "c) Category 3--- Three wheeled motor vehicles with gross vehicle weight exceeding 1.0 T."

C3 Para 7.11, page 3:

Substitute "*Every three wheeled vehicle of Category 1 and 2 shall be fitted with a braking system complying with the requirements given in para a) or b) below. Every three wheeled vehicle of category 3 shall be fitted with a braking system complying with the requirements of para b) below*." for the words "Every three wheeled vehicle shall be fitted with either:"

C4 Para 7.11. sub-para b) Page 3 :
Add the following at the end of sub-para 5)

"6) *In case of three wheelers of category 3, if the requirement given in 7.11(b)(1) above is met by using the same control, the parking brake device shall be so designed that it can be actuated by the driver when the vehicle is in motion with at least one hand on the steering control and shall comply with the requirements for P type dynamic parking brake test given in Table 2. The force exerted on the braking control shall not exceed the values specified in 9.2. Compliance with this requirement shall be deemed to have met if the braking performance has been achieved once."*

C5 Para 8.1.1 Page 4:

Add the following at the end: *"In case of 3 wheelers of Category 3, the P type dynamic parking brake test as specified in 7.11.b) 6 shall also be carried out."*

C6 Para 9.2 Page 4:

Replace the heading on the second and third columns by "3 wheelers of category 1 & 2" and "3 wheelers of category 3", respectively.

C7 **Table 2 Page 5:**

a) Substitute the words *"For Category 2 & 3"* for the words " For category 2" appearing in the first row.

b) Add the following row after entry no. vi)

"vii	*Laden*	*P type dynamic parking brake test {see7.11.b) 6) for category 3*	--	--	--	*30*	*0.1V +V²/ 40*	*1.5*

C8 Para 12.14 Page 9:

Add the following as a new para: "12.14.3 In the case of P type Dynamic parking brake test {see7.11.b) 6) for category 3, one test is sufficient"

Annex : D
Modifications required in AIS-004

D1 Add the following to the Introduction of AIS-004/1999:

"This Standard is amended to include EMI measurement procedure for battery operated vehicles as per recommendations of CMVR Technical Committee. Essentially, the radiated EMI emitted from battery operated vehicle is measured in a wider range i.e. from 9 kHz to 1000 MHz and conducted emission over the frequency range of 450KHz to 30MHz, than that from IC engine vehicles viz. 30 MHz to 1000 MHz. As of now, there is no ECE or EEC Standard on details for radiated emission from 9 kHz to 30 MHz and conducted emission over the frequency range of 450kHz to 30MHz ,hence it is decided to align with technical details available in SAE J 551/5 December 1997 (SAE recommended practice) for both radiated electrical and magnetic emissions and conducted emission for battery operated vehicles.

The test facility for conducted emission are yet to be established. The implementation dates for each of these will be received by CMVR Technical Standing Committee as decided at appropriate time.

For the broad band emission in the frequency range of 30 to 1000MHz, the procedure as per AIS-004 gives an option of using a quasi-peak or peak detector. As the quasi-peak detector is intended for measurement of EMI from the spark ignition system, in the case of BOV's only peak detector is to be used with appropriate correction factors for the limits as prescribed in AIS-004."

D2 Add the following at the end of Clause 6.1.1 of AIS-004/1999:

"iv) For battery operated vehicles Broad Band (Wide Band) radiated electric and magnetic emissions shall be measured over additional frequency range of 9 kHz to 30 MHz .

Every battery operated vehicle when tested for electromagnetic radiation with the method given in this Standard, shall meet the requirements of the limits of radiation as given in Fig. 11 & 12 (for frequency range 9 kHz to 30 MHz)."

D3 Add the following as Clause 6.1.3 in AIS-004/1999

6.1.3 Conducted emission for Battery Operated Vehicle

i) For battery operated vehicles Conducted emission shall be measured over frequency range of 450 kHz to 30 MHz .

ii) Conducted emission measurements are applicable only to battery-charging systems which utilize a switching frequency above 9kHz , are mounted on the vehicle, and whose power is transferred by metallic conductors . Conducted emission requirements apply only during charging of the batteries from AC power line.

iii)Conducted and radiated emissions measurements of battery-charging systems that use an induction power coupling device are not covered by this standard.

iv)Conducted emissions are measured with quasi-peak detector and 9kHz bandwidth.

iv) Limits for conducted emissions are given below

The level for road vehicles and other vehicles not exclusively used in a commercial environment shall be 250μV. The level for vehicles recharged exclusively in a commercial environment are given below.
The measurements are to be made with a quasi-peak detector. Measurements made with a peak detector(9KHz bandwidth min.) that comply with the quasi-peak limits also satisfy the requirements.

Frequency	level with QP detectors
450kHz to 1.705MHz	1mv
1.705MHz to 30MHz	3mv

Following option may be employed if the conducted emissions exceed the limits defined previously when measured using instruments employing a quasi-peak detector: If the level of the emission measured using the quasi-peak instrumentation is 6 dB, or more, above the level measured with instrumentation having an average detector and a 9KHz minimum bandwidth, that emission is considered broadband and the level obtained with the quasi-peak detector may be reduced by 13dB for comparison to the limits. When employing this option, the following shall be observed.

a. The measuring instrumentation with the average detector shall employ a linear IF amplifier.
b. Care must be taken not to exceed the dynamic range of the measuring instrument when measuring an emission with low-duty cycle.

D4 Add the following at the end of Clause 7.1 of AIS-004/1999:

"For battery operated vehicles a peak detector shall be used for measurement of broad band electromagnetic emissions over frequency range of 9 kHz to 30 MHz and measurement of broad band and narrow band radiated electromagnetic emissions over frequency range of 30 MHz to 1000 MHz."

For Conducted emission over the frequency range of 450kHz to 30MHz quasi-peak detector should be used.

Line Impedance Stabilization Network(s) (LISN) For Conducted Emission
The 50 μH , 50 Ω LISN defined in ANSI C63.4 shall be used in each power lead.

The current rating of LISN's shall be greater than the peak current draw of the vehicle being charged. The voltage rating shall be compatible with the power line voltage and frequency being used. The LISN's shall meet the impedance requirement over the frequency range of 450kHz to 30MHz.

The length of cable between the LISN(s) and the connection to the vehicle shall be 1.5 ± 0.05m.

LISN(s) shall be bonded to the ground plane under the vehicle with straps that are as short as possible and that have a maximum length to width ratio of 7.

When more than one LISN(s) is used , each 50Ω port shall be terminated with measuring instrument or 50Ω resistive load.

D5 Add the following at the end of Clause 7.2 of AIS-004/1999:

For battery operated vehicles for frequency range of 9 kHz to 30 MHz, the measurement results shall be expressed in normalized form in dBμV/m/kHz (electric field strength) and dBμA/m/kHz (magnetic field strength) after incorporating the appropriate band width and antenna factors. See 4.5.3 of SAE J551-2 for bandwidth correction. Also following bandwidth shall be used for measuring instrument.

For converting dBμV/m to dBμV/m/kHz at 200Hz bandwidth add 20log(1KHz / 0.2KHz) and at 9KHz bandwidth add 20log(1KHz / 9KHz)

Frequency Band	Instrument Bandwidth	Bandwidth Correction
9 kHz – 150 kHz	200 Hz	14 dB
150 kHz – 30 MHz	9 kHz	-19.1 dB

D6 Add the following at the end of Clause 7.3 of AIS-004/1999:

For battery-operated vehicles for broad band radiated electromagnetic emissions measurement over the frequency range of 9 kHz to 30 MHz, the ambient noise level shall be minimum 6 dB lower than the limits stated in Fig. 11 & 12.

D7 Add the following as Clause 7.4.4 of AIS-004/1999:

ABSORBER-LINED-SHIELDED ENCLOSURE for Conducted Emission :

The conducted emission test should be run in a shielded enclosure (Anechoic chamber) to preclude ambient emission from influencing the test results. The test shall be conducted in accordance with ANSI C63.4

D8 Add the following at the end of Clause 7.5 of AIS-004/1999:

For battery-operated vehicles for measurement of broad band electromagnetic emissions over frequency range of 9 kHz to 30 MHz following antennas shall be used :

a) 1 m vertical monopole antenna with a suitable antenna matching unit. The counterpoise shall be as recommended by antenna manufacturer.

b) 60 cm electro-statically shielded loop antenna CISPR 16-1

Commercially available rod and loop antennas with known antenna correction factors may be used.

D9 Add the following at the end of Clause 7.6 of AIS-004/1999:

For battery operated vehicles for measurement of broad band electromagnetic emissions over frequency range of 9 kHz to 30 MHz, the base of vertical monopole antenna shall be at ground level and 3 m $\pm$0.1 m away from the nearest part of the vehicle.

The center of the loop antenna shall be 1 m $\pm$0.05 m above the ground level and 3 m $\pm$0.2 m away from the nearest part of the vehicle.

The antenna shall be positioned successively on all 4 sides of the vehicle to determine the direction of maximum radiation.

Also the readings shall be taken for the vertical electrical field using rod antenna and all three orthogonal planes for the magnetic field using loop antenna.

Note : The loop antenna orientation for maximum sensitivity to a magnetic field is such that an axis perpendicular to the plane of the loop is also parallel to the direction of magnetic field. The term polarization is sometimes applied to the direction of the axis in the case of loop antennas. Strictly speaking, the term polarization is used to denote the orientation of the electric field, for loop antenna oriented for maximum coupling to the field, the direction of the electric field is parallel to the plane of the loop.

D10 Add the following at the end of para (i) of Clause 7.10 of AIS-004/1999:

The battery-operated vehicle shall be elevated using jack stands as supports and shall be driven at constant speed. Alternatively, If operation of the vehicle in the unloaded state would cause damage to the propulsion system, or result in lower radiated emissions levels , measurements may be made using a dynamometer to load the vehicle at the zero-grade road load.

Measurement of broad band electromagnetic emissions for battery operated vehicles for range 9 kHz to 30 MHz:

Preliminary scan procedure with vehicle running at steady state condition of 40 km/h or the maximum speed of the vehicle if it is less than 40 kmph, shall be carried out on all four sides of the vehicle.

Side where maximum radiation is recorded shall be used for further test. With antenna positioned and oriented for side of maximum radiation, the testing shall be repeated for steady state vehicle running condition of 16 kmph and 64 kmph or maximum speed of the vehicle if it is less than 64 kmph, in order to determine the speed that produces maximum radiation. The vehicle shall be operated at this speed of maximum radiation during all of the testing.

Measurement of broad band electromagnetic emissions from battery operated vehicles over frequency range 30 to 1000 MHz:

The vehicle shall be run with a constant speed of 20 kmph or maximum speed if it is less than 20 km/h.

Measurement conducted emissions from battery operated vehicles over frequency range 450kHz to 30 MHz:

On-Board Charger Measurements (Vehicle propulsion system de-energized)

Measurements shall be made at maximum and trickle charge rates. If the vehicle is designed for charging at more than one power line voltage, the emissions shall be measured at each line voltage. The required test frequency range shall be swept and the data recorded.

If a digital control or switching circuit utilizes a frequency that exceeds 1.705 MHz, then radiated emission tests of the charging system are also required. The measurement shall be made as per the procedure for narrow band radiated emissions in the frequency range of 30 to 1000 MHz.

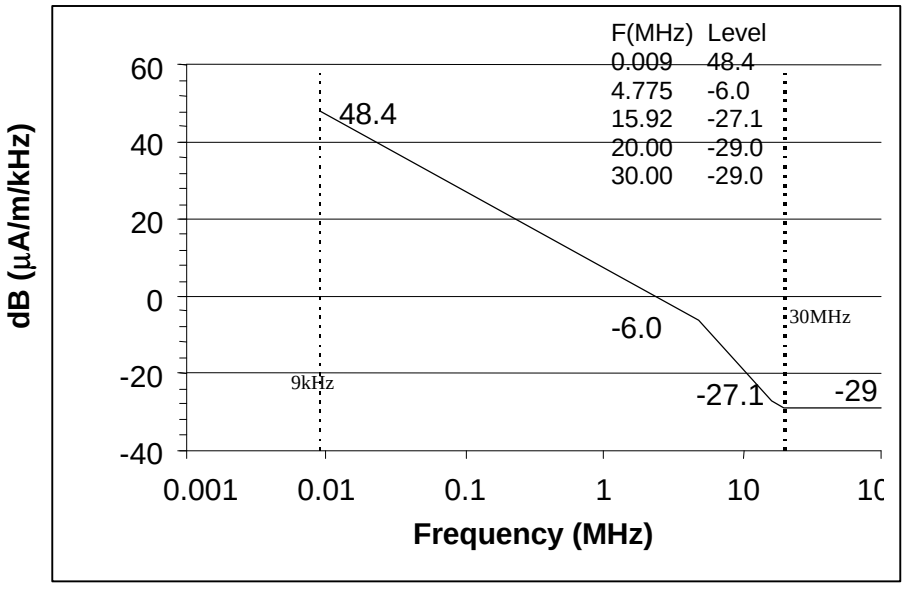
D11 Add the following as Clause 7.12.5 in AIS-004/1999

For measurement of broad band electromagnetic emissions of battery operated vehicles over the frequency range of 9 kHz to 30 MHz, this range shall be divided into minimum of 11 bands with approximately 1 band per frequency of octave. Spot frequency measurements shall be carried out at minimum two frequencies per octave such that the ratio of successive frequencies does not exceed 1.6. As an example, one possible set of bands and spot frequencies would be:

Frequency Band	Spot Frequency 1	Spot Frequency 2
9 – 30 kHz	18 kHz	27 kHz
30 – 60 kHz	35 kHz	55 kHz
60 – 150 kHz	80 kHz	120 kHz
150 – 250 kHz	160 kHz	240 kHz
250 – 500 kHz	300 kHz	450 kHz
0.5 – 1.1 MHz	0.6 MHz	0.9 MHz
1.1 – 2.4 MHz	1.2 MHz	1.8 MHz
2.4 – 5.0 MHz	2.5 MHz	3.75 MHz
5.0 – 10.0 MHz	6.0 MHz	9.0 MHz
10.0 – 20.0 MHz	12.0 MHz	18.0 MHz
20.0 – 30.0 MHz	21.0 MHz	28.0 MHz

D12 The limits as per Figure 11 and Figure 12 for frequency range 20 MHz to 30 MHz shall be same as that for 20 MHz.

Figure 11
Recommended Performance Limit for Normalized Peak Impulse Magnetic Field Strength



The recommended limits are calculated from the formulae given below, rounded off to nearest one tenth as per IS 2.

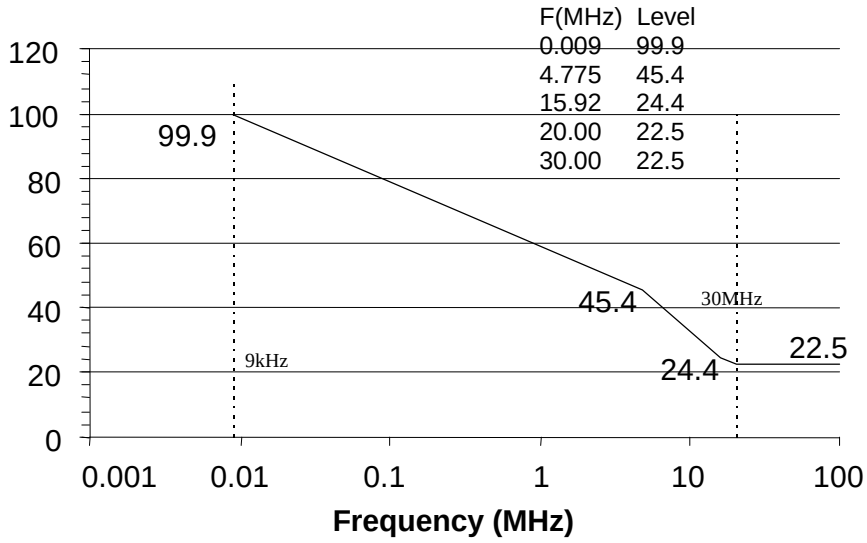
Frequcny Range (MHz)	**Recommended limit dB (µA/m/kHz)**
0.009 to 4.77	$48.4 - 20\text{Log}_{10}(\text{Freq(MHz)}/0.009)$
4.77 to 15.92	$102.9 - 40\text{Log}_{10}(\text{Freq(MHz)}/0.009)$
15.92 to 20	$37.9 - 20\text{Log}_{10}(\text{Freq(MHz)}/0.009)$
20 to 30	-29.0

Recommended limits for the spot frequencies indicated in clause 7.12.5 are tabulated below for ready reference

Spot Frequency 1	Recommended Limit dB (µA/m/kHz)	Spot Frequency 2	Recommended Limit dB (µA/m/kHz)
18 kHz	42.4	27 kHz	38.9
35 kHz	36.6	55 kHz	32.7
80 kHz	29.4	120 kHz	25.9
160 kHz	23.4	240 kHz	19.9
300 kHz	17.9	450 kHz	14.4
0.6 MHz	11.9	0.9 MHz	8.4
1.2 MHz	5.9	1.8 MHz	2.4
2.5 MHz	-0.5	3.75 MHz	-4.0
6.0 MHz	-10.1	9.0 MHz	-17.1
12.0 MHz	-22.1	18.0 MHz	-28.1
21.0 MHz	-29.0	28.0 MHz	-29.0

Minimum Scan Time	
Frequency Band	For Peak detection
9 kHz – 150 kHz	100 ms/KHz
150 kHz – 30 MHz	100 ms/MHz

Figure 12
Recommended Performance Limit for
Normalized Peak Impulse Electric Field Strength



Annex : E
Definitions

E1.0 This Chapter Annexure gives the definitions of the terminology used for Battery Operated Vehicles.

E1.1 "Access Probe" means a test probe simulating in a conventional manner a part of a person or a tool, or the like, held by a person to verify adequate clearance from hazardous part.

E1.2 "Active driving possible mode" means a vehicle mode when application of pressure to the accelerator pedal (or activation of an equivalent control) will cause the drive train to move the vehicle.

E1.3 "Adequate Clearance for Protection Against Access to Hazardous Parts" means a distance to prevent contact or approach of an access probe to a hazardous part.

E1.4 "Approval of a type of battery electric road vehicle" means the approval of a type of electric vehicle regarding construction and functional safety requirements specific to the use of electric energy.

E1.5 "Auxiliary battery" means the battery unit whose reserve of energy is used only for the auxiliary network supply.

E1.6 "Auxiliary network" means the assembly of auxiliary electric equipment with similar functions to the one used on vehicles equipped with an internal combustion engine.

E1.7 "Battery electric road vehicle" means a vehicle with bodywork intended for road use, powered exclusively by an electric motor whose traction energy is supplied exclusively by a traction battery installed in the vehicle.

E1.8 "Battery module" means the smallest single energy storage consisting of one cell or an assembly of cells, electrically connected in serial or in parallel, placed in one container and mechanically associated.

E1.9 "Battery pack" means a single mechanical assembly comprising of battery modules and retaining frames or trays. A vehicle may have one or several, or no battery pack.

E1.10 "Coupling system" means all the parts used to connect the vehicle to an external electric power supply (alternative or direct current supply).

E1.11 "Degree of protection" means the extent of protection provided by an enclosure against access to hazardous parts against ingress of solid foreign objects and/or against ingress of water and verified by standardized test methods.

E1.12 "Direct contact" means contact of persons (or livestock) with the live parts (IEV 826-03-05).
Note : This IEV definition is given for information. In this Standard "Direct contact" is replaced by "Access to hazardous parts".

E1.13 "Drive direction control unit" means a specific device physically actuated by the driver in order to select the drive direction (forward or backward), in which the vehicle will travel if the accelerator is actuated.

E1.1.4 "Drive train" means specific components of power train, such as the traction motors, electronic control of the traction motor, the associated wiring harness and connectors.

E1.15 "Electrical chassis" means a set made of conductive parts electrically linked together, and all other conductive parts electrically linked to them, whose potential is taken as a reference.

E1.16 "Electrical circuit" means an assembly of connected live parts through which an electrical current is designed to pass in normal operation conditions.

E1.17 "Electronic converter" means an apparatus allowing the control and / or transfer of electric energy.

E1.18 " Enclosure" means a part providing protection of equipment against certain external influences and, in any direction, protection against direct contact (IEV 826-03-12).

Note : This definition taken from the existing International Electro technical Vocabulary (IEV) needs the following explanations under the scope of this Standard :

a) Enclosures provide protection of persons (or livestock) against access to hazardous parts.

b) Barriers, shapes of openings or any other means – whether attached to the enclosure or formed by the enclosed equipment – suitable to prevent or limit the penetration of the specified test probes are considered as a part of the enclosure, except when they can be removed without the use of a key or tool.

E1.19 "Exposed conductive part" means any conductive part, which can readily be touched and which is not normally alive, but which may become electrically energized under fault conditions.

E1.20 "Hazardous Live Part" means a live part, which, under certain conditions of external influences can give an electric shock (see IEC 536, at present Document 64 (CO) 196).

E1.21 "Hazardous Mechanical Part" means a moving part, other than a smooth rotating shaft, that is hazardous to touch.

E1.22 "Hazardous part" means a part that is hazardous to approach or touch.

E1.23 "Indirect contact" means contact of persons or livestock with exposed conductive parts.

E1.24 "IP code" means a coding system to indicate the degrees of protection provided by an enclosure against access to hazardous parts, ingress of solid foreign objects, ingress of water to give additional information in connection with such protection.

E1.25 "Key " means any device designed and constructed to provide a method of operating a locking system, which is designed and constructed to be operated only by that device.

E1.26 "Live parts" means any conductor or conductive part(s) intended to be electrically energised in normal use.

E1.27 "Maximum Mass" means the technically permissible maximum mass declared by the Manufacturer. Also referred as GVW.

E1.28 "Maximum Thirty Minute Power" means the maximum net power at wheels of an electric vehicle drive train at appropriate rated voltage, which the vehicle drive train can deliver over a period of 30 minutes as an average.

E1.29 "Maximum thirty- minutes speed of the vehicle" means the maximum speed at which the vehicle runs continuously for thirty minute, with the battery in the fully charged condition.

Maximum thirty- minute speed of the vehicle can be measured on the chassis dynamometer by running the vehicle with the battery in full charged condition. The maximum speed at which the vehicle runs continuously for 30 minute is the maximum thirty- minute speed of the vehicle.

E1.30 "Net Power" means the power obtained at the wheels of electric vehicle when tested on chassis dynamometer at corresponding vehicle speed at reference atmospheric conditions.

E1.31 "Normal voltage" means the root –mean – square (r.m.s.) value of the voltage specified by the Manufacturer, for which the electrical circuit is designed and to which its characteristics are referred.

E1.32 "Object Probe" means a test probe simulating a solid foreign object to verify the possibility of ingress into an enclosure.

E1.33 "Off-board charger" means an energy electronic converter used for charging battery from an external power supply (mains network) and which is not the integral part of the vehicle

E1.34 "On-board charger" means an energy electronic converter linked by construction to the vehicle and used for charging the traction battery from an external electric power supply (mains network).

E1.35 "Opening" means a gap or aperture in an enclosure, which exists or may be formed by the application of a test probe at the specified force.

E1.36 "Passenger and load compartment" means the space in the vehicle for occupant accommodation and bounded by the roof, floor-side walls, outside glazing, front bulkhead and the plane of the rear-seat back support and eventually the partition between it and the compartment(s) containing the battery modules.

E1.37 "Power train" means the electrical circuit including :

1) The traction battery;
2) The electronic converters (on-board charger, electronic control of the traction motor, DC/DC converter, etc.);
3) The traction motors, the associated wiring harness, connectors, etc.
4) The charging circuit;
5) The power auxiliary equipment (e.g. heating, defrosting, and power steering)

E1.38 "Reference Mass" means the unladen mass of the vehicle increased by a figure of 75% of the Pay Load for vehicles with GVW upto 7.5 ton

E1.39 "Traction battery" means the assembly of all battery modules, which are electrically connected, for the supply of energy of the power circuit.

E1.40 "Unladen Mass " means the mass of the vehicle in running order without driver, crew, passengers or load , but with the fuel tank full (if any), cooling liquid, service and traction batteries, oils, onboard charger, portable charger, tools and spare wheel, whatever is appropriate for the vehicle considered and if provided by the manufacturer of the vehicle;

E1.41 "Vehicle type" means battery electric road vehicles, which do not differ in such essential aspects as:
dimensions, structure , shape and nature of constituting materials, installation of the power system components , battery or battery packs, tyres, unladen mass,. nature and type of electric and electronic components .

E1.42 "Working voltage" means the highest root –mean – square (r.m.s.) value of an electrical circuit voltage, specified by the manufacturer, which may occur across any insulation, in open circuit conditions or under normal driving & servicing conditions.

Annex : F (See 7.4)
Criteria for Extension

F1.0 In case of following changes, the verification tests which are necessary for establishing compliance are listed below

	Changes of Parameter	Tests to be conducted
F1.1	Type of motor, controller, battery	Range test, Energy consumption test, Power test, All tests/verifications as per AIS-038, Gradeability, EMI, and if fitted with regenerative braking of category B, brake test.
F1.2	Layout of battery, controller, motor	All applicable tests/verifications as per AIS-038.
F1.3	Working Voltage	All tests
F1.4	Make, model of on-board charger	Tests as per 3.3.124 to 3.3.14.3 of AIS-038
F1.5	Vehicle body construction affecting aerodynamic resistance	Coast-down, range, energy consumption, 30-minute maximum speed.
F1.6	Wiring harness of Traction battery	EMI

F1.7 In the case of tests affecting range, 30-minute maximum speed, energy consumption because of change in reference mass, coast-down parameters etc. the conditions given in MOST/CMVR/TAP-115/116 shall be applicable

F1.8 Changes in parameter affecting general performance requirements of CMVR (E.g. brakes, noise etc.) shall be as per details given in the individual standards.

F2.0 For changes other than the above, the provisions given in the Preamble of Annex C of AIS-017/2000 (Procedure For Type Approval And Certification Of Vehicles For Compliance To Central Motor Vehicles Rules) may be followed.

Annex : G
(See Introduction)
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