Amendment 2 (01/2020)
To
AIS 048: 2009
Battery Operated Vehicles -
Safety Requirements of Traction Batteries

1.	**Page No. 3/16 Clause No 2.2.1.1**
	Replace first paragraph with following text:
	Battery module shall be subjected to this test. Test shall be carried out at test room temperature not exceeding 30°C. Vibration test will be carried out in three –axis viz. x, y, z in the vertical axis and horizontal axis, and battery positioned in longitudinal direction).
2.	**Page No. 4/16 Clause No 2.2.1.1**
	Replace last paragraph with following text:
	The battery module shall be subjected to sinusoidal vibration for at an acceleration of 3 g in three axis and a frequency of 30-150 Hz at a sweep rate of 1 octave per minute. Testing is to be carried out for 2 hours in each axis.
3.	**Page No. 4/16 Clause No 2.2.2.1**
	Replace first paragraph with following text:
	Battery module shall be subjected to this test. Test to be carried out at test room temperature not exceeding 30°C. Shock test will be carried out in three-axis viz. x ,y ,z in the vertical axis and horizontal axis, and battery positioned in longitudinal direction.
4.	**Page No. 5/16 Clause No 2.2.4**
	Substitute following text for existing test:
	2.2.4 Penetration Test (Cell Level or Battery module) Test may be carried out on battery cell or battery module as opted by the manufacturer with fully charged (100% SOC) condition. This test is for internal short circuit simulation. If manufacture opts to do nail penetration test on module level, then a hole to be pre-drilled in the enclosure of the battery module, so that through three cells or 100 mm minimum depth of penetration can be achieved.
5.	**Page No. 6/16 Clause No 2.2.4.2**
	Replace existing table with below

		Size of Test Object	**Diameter of Rod**	**Minimum Depth of Penetration**	
		Battery Cell (Cell geometry such as Cylindrical 18650, Pouch cell, Prismatic cell etc)	3 mm	Through Cell	
		Battery Module (Module of prismatic cell or lead acid battery etc.)	20 mm	Through three cells or 100 mm	

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

17th January 2020

Amendment No 1 28 September 2016

To

AIS 048: 2009

Battery Operated Vehicles -Safety Requirements of Traction Batteries

1. Page No. 7/16 Clause No 6.3.3

Substitute following text for existing test:

6.3.3 Shock Test (2.2.2)

2. Page No. 7/16 Clause No 6.4

Substitute following text for existing test:

The frequency of verification of continued compliance (surveillance check) by the testing agency shall be as per AIS 037, as amended from time to time.

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

28th September 2016

AIS-048

AUTOMOTIVE INDUSTRY STANDARD

Battery Operated Vehicles - Safety Requirements of Traction Batteries

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

ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

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

March 2009

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 document on their website.

This Standard prescribes the safety requirements of traction batteries for battery operated vehicles.

Considerable guidance has been taken from the following documents:

1. USABC ELECTRIC VEHICLE BATTERY TEST PROCEDURES MANUAL, Revision 2, Published January 1996.
2. United States Advanced Battery Consortium Electrochemical Storage System Abuse Test Procedure Manual, Printed July 1999
3. IS 13514 – 1992 : Lead acid batteries for electric road vehicles – Specification.
4. IEC : 60254

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

Battery Operated Vehicle – Safety Requirements of Traction Batteries

0. SCOPE

This standard applies to the traction (driving power) batteries used for battery operated vehicles of L, M and N category vehicles as defined in AIS-053.

1. REFERENCES

AIS-037	Procedure for Type Approval and Establishing Conformity of Production for Safety Critical Components
AIS-007 (Rev. 03)	Information on Technical Specifications to be submitted by the Manufacturer
AIS-053	Automotive Vehicles – Types – Terminology

The definitions applicable to this standard are given in Annex-C.

2. REQUIREMENTS

2.1 Electrical Tests

2.1.1 Short Circuit Test (Cell Level or Battery Module or Battery Pack)

Test may be carried out on battery cell (if the electrodes are approachable) or battery module or battery pack, as opted by the manufacturer.

2.1.1.1 Procedure for Short Circuit Test

With the Battery at nominal operating temperature as specified by the manufacturer, fully charged condition at test room temperature not exceeding 30°C, apply a hard short in less than one second to the Battery with a conductor of ≤ 5mΩ for 10 minutes, or until another condition occurs which prevents completion of the test (i.e., component melting, etc.), or for systems with less than ≤ 0.9 mΩ/V system voltage ± 0.1mΩ internal resistance, a conductor of 1/10 of the minimum resistance of the cell/module shall be used.

The size of conductor shall be such that, it shall be able to withstand the short circuit current during the test duration.

If the multiple module is available, test a module that has been removed from its standard container.

If more than one module is tested, increase the resistance to minimum extent required, in order to apply reduced short circuit currents, to avoid burn-out of cell interconnects within the test article. The load resistance chosen for such testing depends on rated voltage of the modules in question.

This test will be performed with integrated, passive short circuit protection devices operational (e.g., integrated devices that require no external input).

All non-passive protective devices shall be disabled prior to this test. Continue observation for an additional two-hour period for the requirements given in clause 2.1.1.2.

2.1.1.2 **Requirements**

At the end of the test, there shall be no :

a) Physical damage to the casing or other mechanical parts.
b) Melting of components.
c) Fire or explosion.

It is acceptable for the battery to become dry at the end of the test.

2.1.2 Overcharge Test (Cell Level or Battery module or Battery Pack)

2.1.2.1 Procedure for Overcharge Test

With the battery at its designed operating temperature as specified by the manufacturer, fully charged (100% SOC), contained at ambient temperature at 27 ± 5^0C. The battery is to be overcharged at a constant charging current of $0.1(C_{10})$ A value for a test duration of ten hours is reached.

2.1.2.2 Requirements

At the end of the test, there shall be no :

a) Physical damage to the casing or other mechanical parts.
b) Melting of components.
c) Fire or explosion.

2.2 Mechanical Tests

2.2.1 Vibration Test

2.2.1.1 Test Description

Battery module shall be subjected to this test. Test shall be carried out at test room temperature not exceeding 30°C. Vibration test will be carried out in two-axis viz. in the vertical axis and horizontal axis, and battery positioned in longitudinal direction).

The cells battery module shall be firmly held on the vibration table similar to the mounting used in the vehicle. as recommended by the manufacturer.

If the support structure has any resonance below 50 Hz, the input will be determined by the average of the acceleration at each of the major support points.

At the beginning of the vibration test, battery module shall be charged to 100% SOC. Where applicable, the electrolyte shall be at the level recommended by the manufacturer.

The battery module shall be subjected to sinusoidal vibration for at an acceleration of 3 g in both the axis and a frequency of 30-150 Hz at a sweep rate of 1 octave per minute. Testing is to be carried out for 2 hours in each axis.

2.2.1.2 Requirements

2.2.1.2.1 Where applicable, during vibration test there shall be no electrolyte loss.

2.2.1.2.2 Immediately after the vibration test, discharge the battery at test room temperature not exceeding 30°C, at the rate of I = 0.2xBattery capacity, declared by the manufacturer in Clause 3.0. The deterioration of battery rated capacity shall not be more than 10%.

At the end of the test, there shall be no :

a) Physical damage to the casing or other mechanical parts
b) Fire or explosion.

2.2.2 Shock Test

2.2.2.1 Test Description

Battery module shall be subjected to this test. Test to be carried out at test room temperature not exceeding 30°C. Shock test will be carried out in two-axis viz. in the vertical axis and horizontal axis, and battery positioned in longitudinal direction.

The battery module shall be firmly held on the vibration table as recommended by the manufacturer.

If the support structure has any resonance below 50 Hz, the input will be determined by the average of the acceleration at each of the major support points.

At the beginning of the shock test, battery module shall be charged to 100% SOC

Where applicable, the electrolyte shall be at the level recommended by the manufacturer.

The battery shall be subjected to the 10 shocks in each axis in half-sine wave, 30 g amplitude and 15 ms duration.

2.2.2.2 Requirements

2.2.2.2.1 Immediately after the shock test, discharge the battery at temperature not exceeding 30°C, at the rate of I = 0.2 x Battery capacity declared by the vehicle manufacturer in Clause 3.0. The deterioration of battery rated capacity shall not be more than 10%.

2.2.2.2.2 At the end of the test, there shall be no :

a) Physical damage to the casing or other mechanical parts
b) Fire or explosion.

2.2.3 Roll-Over Test (Battery Module) (applicable only for flooded lead acid batteries)

Test may be carried out on battery module.

2.2.3.1 Test Description

Rotate the battery module one complete revolution in one direction, for one minute in a continuous, slow-roll fashion, and observe leakage, if any, from the battery module. Then rotate the battery module in 90° increments in same direction for one full revolution. Hold the battery module for one hour at each position.

2.2.3.2 Requirements

The volume of electrolyte spilled in each position shall not be more than 25 ml per module.

2.2.4 Penetration Test (Cell Level or Battery module)

Test may be carried out on battery cell or battery module as opted by the manufacturer.

2.2.4.1 Test Description

The battery cell module shall be penetrated with a mild steel (conductive) pointed rod, which will be electrically insulated from the test fixture. The rate of penetration shall be 8 cm/s nominal. The diameter of the rod and the depth of penetration as specified in clause 2.2.4.2. The orientation of the penetration shall be perpendicular to the electrode plates. The test should be run in an indoor facility in a container so as to collect the electrolyte from the safety point of view.

The battery should be observed, with the rod remaining in place, for a minimum of one hour after the test.

Note : The test may be carried out using a pendulum, hydraulic actuator or pneumatic actuator

2.2.4.2 Test Specifications

Size of Test Object	Diameter of Rod	Minimum Depth of Penetration
Battery Cell	3 mm	Through cell
Battery Module	20 mm	Through three cells or 100 mm

2.2.4.3 Requirements

At the end of the test, there shall be no:

a) Melting of components.
b) Fire or explosion.

3.0 BATTERY PARAMETERS

3.1 The manufacturer shall declare battery capacity and charge retention arrived as per the method given in Annex A.

3.2 These parameters if to be declared in Table 13 of AIS-007 (Rev. 03) by the vehicle manufacturer shall also be as per the method given in Annex A.

3.3 The specification of battery declared as per the prevailing table 13 of AIS-007 (Rev. 03) for already type approved BOV's are based on 2h and not 5h capacity. In such cases, the values as per 2h shall also be declared for applying the criteria of extension for deciding the test required due to change in such parameters for type approval of BOV.

4 APPLICATION FOR APPROVAL

4.1 Information to be submitted by the manufacturer at the time of applying for type approval of the battery shall be as given in Annex B.

4.2 Number of samples: Generally 6 samples are required. If the manufacturer opts for carrying out vibration and shock test on the same sample, only 5 samples are to be submitted.

5.0 CHANGES IN TECHNICAL SPECIFICATION

5.1 Every modification pertaining to the information, even if the changes are not technical in nature declared in accordance with clause 4 shall be intimated by the manufacturer to the certifying agency.

If the changes are in parameters not related to the provisions, no further action need be taken.

If the changes are in parameters related to the provisions, the Testing Agency, which has issued the certificate of compliance, shall then consider, whether,

5.1.1 The model with the changed specifications still complies with provisions, or

5.1.2 Any further verification is required to establish compliance.

5.2 For considering whether testing is required or not, guidelines given in clause 5.5 (Criteria for Extension of Approval) shall be used.

5.3 In case of clause 5.1.2, tests for only those parameters which are affected by the modifications need be carried out

5.4 In case of fulfillment of criterion of clause 5.1.1 or after results of further verification as per clause 5.1.1 are satisfactory, the approval of compliance shall be extended for the changes carried out.

5.5. Criteria for Extension of Approval

5.5.1 The test carried on a level shall be applicable for approving a higher level.

5.5.2 In the case of partial short circuit test, test need not be carried out if the number of cells to be shorted remains same as per Table 1.

5.5.3 In the case of change in type of battery, all the tests to be conducted.

5.5.4 In case of changes other than above, the criteria shall be as agreed between the test agency and manufacturer.

6.0 CONFORMITY OF PRODUCTION (COP)

6.1 The conformity of production procedures shall be those set out in AIS-037 as and when notified to make it applicable for this standard.

6.2 Batteries approved under this standard shall be so manufactured as to conform to the type approved specification set in this standard.

6.3 For the purpose of establishing COP, the following requirements shall be verified.

6.3.1 Short circuit test (clause 2.1.1)

6.3.2 Overcharge test (clause 2.1.2)

6.3.3 Roll over test (clause 2.2.3)

6.4 The frequency of verification of continued compliance (surveillance check) by the testing agency shall be once in three years.

ANNEX - A
(See clause 3.0)

These guidelines are intended only for the declaration by the manufacturer. No tests as per these guidelines are required to be carried out as part of this standard.

A-1 Rated Capacity

The rated capacity assigned to the battery by the manufacturer shall be the capacity expressed in ampere hours (after correction to 30°C) obtainable when the battery is discharged as per the following procedure.

A-1.1 Test for Capacity

After standing on open circuit for not less than 2 hours and not more than 12 hours from completion of full charge, the cell shall be discharged as specified in A-1.2 and A-1.3. The specific gravity and level of electrolyte shall be checked after the full charge and adjusted, if necessary.

A-1.2 The cell shall be discharged through a suitable variable resistance at a constant current I = 0.20 (rated capacity declared by the battery manufacturer) *A, until the terminal voltage falls to 1.70 V.

A-1.3 During the discharge, the following values shall be noted at * suitable intervals:

a) Terminal voltage of the cell
b) The discharge current, and
c) The temperature of the electrolyte

* The voltages shall be checked at the following intervals in the case of lead acid batteries

a) Every 30 minutes up to 1.90 V per cell,
b) Every 15 minutes thereafter till 1.80 V per cell, and
c) Every 5 minutes thereafter.

For other type of batteries, values declared by the manufacturer shall be used

A-1.4 The time in hours from the commencement of discharge until the terminal voltage has fallen to 1.70 V per cell is the duration of discharge (a in the formula given in A-1.5).

A-1.5 The capacity in ampere-hours at t°C is:

$Ct\ °C = a \times I$ (rated capacity declared by the battery manufacturer)

where

a = discharge duration in hours,
t°C = average value of the initial and final electrolyte temperature.

A-1.6 The rated capacity is defined at a reference temperature of 30°C. If the average temperature t°C during the discharge differs from 30°C, the capacity measured shall be correlated to 30°C by using the following formula:

$C30°C = Ct/1\ 0.006 + (t - 30)$

The figure 0.006 represents the temperature coefficient of variation of capacity of 0.6 percent per °C for lead acid batteries.

For other type of batteries, values to be declared by manufacturer shall be used.

A-2 Charge Retention Test

A-2.1 After having undergone a capacity test and having obtained a capacity, its surface shall be cleaned and dried in order to remove any traces of conductive material or electrolyte.

A-2.2 The battery shall be stored on open circuit (that is without a connected electric load) at an average electrolyte temperature of 25± 5°C for a period of 28 days (672 h).

A-2.3 At the end of the open circuit storage, in accordance with A-2.2 the temperature of the electrolyte is adjusted to the range indicated in A-1.5 and A-1.6. Then the residual capacity Cr shall be determined by a discharge at the current in accordance with A-1.2 and thereafter in accordance with A-1.4.

A-2.4 The residual capacity Cr shall be not less than 0.80 rated capacity.

A-2.5 After the test, the battery shall be fully recharged in accordance with A-1.1.

ANNEX-B
(See clause 4)

TECHNICAL SPECIFICATION TO BE SUBMITTED

B-1.	Trade name or mark of the device:
B-2.	Manufacturer's name:
B-3.	Manufacturer's address:
B-3.1	Telephone No
B-3.2	FAX. No.
B-3.3	E mail address
B-4.4	Contact person
B-4.	If applicable, name and address of manufacturer's representative:
B-5	Description (Type) of The Traction Battery (Battery cell / Battery module /Battery pack)
B-5.1	Battery designation/identification
B-6	Kind of Electro – Chemical Couple
B-7	Nominal Voltage , V
B-8	Battery Maximum Thirty Minutes Power (Constant Power Discharge), kW
B-9	Battery Performance in 5 h Discharge (Constant Power or Constant Current)
B-10	Battery Energy , kWh
B-11	Battery Capacity , Ah in 5 h
B-12	End of Discharge Voltage Value , V
B-13	Battery Mass, kg
B-14	No. of cells per battery module
B-15	In case of pack, no. of battery modules per pack
B-16	Operating Temperatures (^{O}C)
B-16.1	Nominal
B-16.2	Maximum
B-16.3	Designed and range
B-17	Option for conducting Short Circuit Test (at Cell Level or Battery module or Battery pack)
B-18	Option for conducting Partial Short Circuit Test (at Battery Module or Battery pack)
B-19	Option for conducting Overcharge Test (at Cell Level or Battery module or Battery pack)
B-20	Option for conducting Penetration Test (at Cell Level or Battery module)
B-21	Internal resistance, of battery if less than <=5mΩ

B-22	Recommendation for mounting and clamping for vibration and shock test.
B-23	Additional information, only in case of batteries for use on BOV's already type approved.
B-23.1	Battery Capacity , Ah in 5 h (Constant Current)
B-23.2	Battery Energy , kWh
B-23.3	Battery Capacity , Ah in 2 h

ANNEX C

DEFINITIONS

(See Clause 2)

C-1	**Anode**	The electrode in an electrochemical cell at which oxidation takes place. During discharge, the negative terminal of the cell is the anode; however, during charge, the positive terminal of the cell is the anode. For rechargeable batteries, the electrodes are normally referred to according to the reactions that occur during discharge.
C-2	**Battery**	Electrochemical cells electrically connected in a series and/or parallel arrangement.
C-2.1	**Battery cell**	An assembly of at least one positive electrode, one negative electrode, and other necessary electrochemical and structural components. A cell is a self-contained energy conversion device whose function is to deliver electrical energy to an external circuit via a controlled internal chemical process. This chemical-to-electrical energy conversion process involves ionic transport between electrodes having different potentials.
C-2.2	**Battery module**	The smallest grouping of physically and electrically connected cells that can be replaced as a unit. A module can be thought of as the smallest, repeating building block of a battery pack.
C-2.3	**Battery pack**	An array of interconnected modules that has been configured for its intended energy storage application, that is, the configuration is application dependent.
C-2.4	**Battery system**	Completely functional energy storage system consisting of the pack(s) and necessary ancillary subsystems for physical support, thermal management, and electronic control.
C-3	**Capacity {C} (Ah)**	The total number of Ampere-hours that can be withdrawn from a fully charged battery under specified conditions.
C-3.1	**Available, or Deliverable, Capacity (Ah)**	The total ampere-hours that can be withdrawn from a fully charged cell or battery for a specific set of operating conditions including discharge rate, temperature, age, stand time, and any discharge cutoff criteria specified by the battery manufacturer.
C-3.2	**Ci (Ah)**	The capacity in Ampere-hours obtained from a battery discharged at a constant current to an end-of-discharge condition (discharge cutoff voltage) in precisely i hours. Ci is established once and is not adjusted through the battery's life.
C-3.3	**Energy Output, or Energy Capacity (Wh)**	The total watt-hours that can be withdrawn from a fully charged battery for a specific set of operating conditions including temperature, rate, age, stand time, and discharge cutoff criteria (specified by battery manufacturer).

C-3.4	**Rated capacity (Ah)**	The developer's or manufacturer's specification for capacity. This single value is chosen by the manufacturer to best represent the expected performance of the battery.
C-3.5	**Residual capacity (Ah)**	The Ampere-hours that can be discharged from a battery at a specified discharge rate and temperature after it has been exposed to specified conditions, such as driving-profile or open-circuit stand tests.
C-3.6	**Specific capacity (mAh/g)**	Capacity per unit weight of active material. This term is usually applied to active materials and/or electrodes (that is, including current collectors).
C-3.7	**Theoretical capacity (Ah)**	The capacity of a cell's active material, assuming 100% utilization.
C-3.8	**Capacity area density (mAh/cm^2)**	The electrochemical capacity of active material per unit electrode area.
C-4	**Cathode**	The electrode in an electrochemical cell at which reduction takes place. During discharge, the positive terminal of the cell is the cathode; however, during charge, the negative terminal of the cell is the cathode. For rechargeable batteries, the electrodes are normally referred to according to the reactions that occur during discharge.
C-5	**Charge**	Conversion of electrical energy into chemical potential energy within a cell by the imposed passage of a direct current.
C-6	**Charge profile**	Schedule used for charging a battery. For example:
C-6.1	**Constant current charging {CI}**	Charging of a battery at a controlled, constant rate of electron flow (normally applied with a maximum voltage limit).
C-6.2	**Constant voltage (potential) charging {CV}**	Charging of a battery by applying a constant voltage while allowing the current to vary (normally applied with a maximum current limit).
C-6.3	**CI/CV**	A constant current charge followed by a constant-voltage charge.

C-7 **Charge rate {Ci /X} (A)** The current applied to a battery to restore its available capacity. The current can be expressed in amperes, but more commonly it is normalized to the rated capacity I of the battery, and expressed as Ci /X, where i is the hour rate for the rated capacity, and X is a time specification, usually in hours. If i is not given, it is assumed to be the same as X. For example, the 10-hour charge rate of a 500-ampere-hour battery (rated at the 5-hour discharge rate) is expressed as

$$\frac{\text{Rated capacity}}{\text{Charge time}} = \frac{\text{500 ampere-hours}}{\text{10 hours}} = 50 \text{ amperes} = C_{10} \text{ at } I_{10} \text{ A.}$$

C-8 In contrast, the capacity of the same battery rated at the 3-hour discharge rate might be 450 Ampere-hours, giving a 10-hour charge rate of

$450/10 = 45A = C_3 /10$ rate.

C-9 **Depth-of-discharge {DOD} (%)** The ratio of the net Ampere-hours discharged from a battery at a given rate to the rated capacity.

C-10 **Discharge** Spontaneous conversion of chemical potential energy into electrical energy within a cell, which results from allowing the passage of direct current.

C-11 **Discharge rate {Ci /X} (A)** The current during discharge of a battery. The current can be expressed in amperes, but more commonly it is normalized to the rated capacity I of the battery, and expressed as Ci /X, where i is the hour rate for the rated capacity, and X is a time specification, usually in hours. If i is not given, it is assumed to be the same as X. For example, the 10-hour discharge rate of a 500-ampere-hour battery (rated at the 10-hour discharge rate) is expressed as

$$\frac{\text{Rated capacity}}{\text{Discharge time}} = \frac{\text{500 ampere-hours}}{\text{10 hours}} = 50 \text{ amperes} = C_{10} \text{ at } I_{10} \text{ A.}$$

In contrast, the capacity of the same battery rated at the 3-hour discharge rate might be 450 Ampere-hours, giving a 10-hour discharge rate of

$450/10 = 45A = C_3 /10$ rate.

C-12 **Discharge Voltage Limit** The minimum voltage under load permitted during performance of the Peak Power Test and other performance tests. It is equal to 2/3 of the open circuit voltage at 80% DOD at beginning of life, unless the manufacturer specifies a more restrictive (higher) value.

C-13	**Electrode**	The conducting body that contains active materials and through which current enters or leaves a cell.
C-14	**Electrolyte**	The medium that provides ion transport between the positive and negative electrodes of a cell. It may participate directly in the charge/discharge reactions.
C-15	**End-of-charge voltage {EOCV} (V)**	The battery voltage when charge is terminated. End-of-discharge voltage
C-16	**End-of-discharge voltage {EODV} (V)**	The battery voltage when discharge is terminated.
C-17	**Hour rate (h)**	The charge or discharge current of a battery expressed in terms of the length of time a new, fully charged battery can be discharged at a specific current before reaching a specified end-of-discharge voltage. For example, the 10-hour rate for discharging a 500-ampere-hour cell (rated at the 5-hour rate) would be 50 amperes.
C-18	**Internal impedance (ohm)**	Opposition to the flow of an alternating current at a particular frequency in a battery at a specified state-of-charge and temperature.
C-19	**Internal resistance (ohm)**	Opposition to direct current flow in a battery. Its value may vary with the current, state-of-charge, age, and temperature. It is the sum of the ionic and electronic resistances of the cell components.
C-20	**Nominal operating voltage (V)**	The voltage of a battery, as specified by the manufacturer, discharging at a specified rate and temperature.
C-21	**Overcharge (Ah)**	The amount by which the charge Ampere-hours exceed the Ampere hours removed on the previous discharge, sometimes reported as a percentage. Occasionally, this excess is normalized to the rated capacity.
C-22	**Power continuous (W)**	A power level characteristic of a battery providing constant power for constant speed vehicle operation. Nominally, the power level required to remove 75% of the rated energy from the battery in 1 hour.
C-23	**Short-circuit current (A)**	That current delivered when a battery is short-circuited (i.e., the positive and negative terminals are directly connected with a low-resistance conductor).
C24	**Traction battery**	Battery for providing the only source of motive power to the motor vehicle.
C25	**Manufacturer**	The manufacturer of the battery or manufacturer of the BOV who has applied for type approval of the battery.

ANNEX D
(See Introduction)

COMMITTEE COMPOSITION *

Automotive Industry Standards Committee

Chairman	
Shri Shrikant R. Marathe	Director The Automotive Research Association of India, Pune
Members	**Representing**
Representative from	Ministry of Shipping, Road Transport & Highways (Dept. of Road Transport & Highways), New Delhi
Representative from	Ministry of Heavy Industries & Public Enterprises (Department of Heavy Industry), New Delhi
Shri S. M. Ahuja	Office of the Development Commissioner, Small Scale Industries, Ministry of Small Scale Industries, New Delhi
Shri Rakesh Kumar	Bureau of Indian Standards, New Delhi
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Dr. C. L. Dhamejani	Vehicles Research & Development Establishment, Ahmednagar
Representatives from	**Society of Indian Automobile Manufacturers**
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Mrs. Rashmi Urdhwareshe
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* At the time of approval of this Automotive Industry Standard (AIS)