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Indian Standard

LEAD ACID BATTERIES FOR ELECTRIC ROAD VEHICLES — SPECIFICATION

UDC 621·355·2 : 629·113·066

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

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Price Group 6

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Secondary Cells and Batteries Sectional Committee had been approved by the Electrotechnical Division Council.

This standard deals with the lead acid batteries for electric road vehicles powered by high energy density batteries up to 300 Ah capacity. Higher capacity batteries shall be added later.

Lead acid batteries for electric road vehicles are generally similar to the conventional batteries covered by IS 5154 : 1980 'Specification for lead acid traction batteries (*first revision*)' except for the following requirements:

a) Higher energy density of the order of min 30 Wh/kg and since beyond;
b) Construction shall be such that it needs minimum possible attention and maintenance;
c) Electrolyte level indicators;
d) Centralized watering system (optional);
e) Ability to withstand higher vibration;
f) Cyclic endurance life of minimum 1 000 with a scope of development for 1 200 cycles and beyond;
g) Special light-weight casings not affected with corrosion due to electrolyte; and
h) Nominal voltage and dimensional requirements.

In electric road vehicles application, the current drawn by the motor during start and acceleration is very high as compared to the rated current. Hence a test for high rate discharge is included in this standard.

Annex A on Schedule of design particulars and Annex B Schedule of performance to be supplied by manufacturer with his quotation, have been included in this standard.

The requirements of charger for electric vehicles battery are given in Annex C.

In the preparation of this standard, assistance has been derived from IEC Pub 254-1 (1983) 'Lead acid traction batteries : Part 1 General requirements and method of test' issued by the International Electrotechnical Commission (IEC).

Indian Standard

LEAD ACID BATTERIES FOR ELECTRIC ROAD VEHICLES — SPECIFICATION

1 SCOPE

1.1 This standard lays down performance requirements and methods of tests of high energy density lead acid batteries for use on battery powered road vehicles and other applications.

1.2 These batteries shall provide power to dc motor drive of motor and to the auxiliary light, horn and fan circuit.

2 REFERENCES

2.1 The following Indian Standards are necessary adjucts to this standard:

IS No.	*Title*
266 : 1977	Specification for sulphuric acid (*second revision*)
1069 : 1964	Specification for water for storge batteries (*revised*)
1885 (Part 8) : 1986	Electrotechnical vocabulary : Part 8 Secondary coils and batteries (*first revision*)
3116 : 1965	Specification for sealing compound for lead-acid batteries
3202 : 1965	Code of practice for climate proofing of electrical equipment
5114 : 1980	Specification for reflectroized signs for mines
8320 : 1982	General requirements and methods of test for lead-acid storage batteries (*first revision*)

3 TERMINOLOGY

3.0 For the purpose of this standard, the definitions given in IS 1885 (Part 8) : 1986 in addition to the following, shall apply.

3.1 Cell

A 2-volt unit to be used to supply power to battery powered road vehicles.

3.2 Tray

An outer container of fibre glass reinforced plastic (FRP) or any other suitable light weight material to accommodate required number of cells.

3.3 Vent Plug

A removable plug for fitting into the filler hole of a cell.

3.4 Intercell Connector Shround

A device fitted to the end of a flexible cable to form a connection between the cable and the battery unit.

3.5 Tapered Cable Thimble

A device fitted to the end of a flexible cable to form a connection between the cable and the battery unit.

3.6 Thimble Socket

A fitting which forms the connection between the end terminal post and tapered cable thimble.

3.7 Type Test

Test carried out to prove conformity with the requirements of this standard. These are intended to prove the general quality and design of a given type of cell.

3.8 Acceptance Test

Test carried out on samples selected from a lot for the purpose of verifying the aceptability of the lot.

3.9 Routine Test

Test carried out on every cell.

3.10 Lot

All cells of the same type, design and rating manufactured by the same factory during the same period, using the same process and materials offered for inspection at a time shall constitute a lot.

3.11 Opportunity Charging

A partial charge generally governed automatically depending upon the state of charge of battery as and when the opportunity for charging is available.

4 MATERIALS AND CONSTRUCTIONAL REQUIREMENTS

4.1 Assembly

The complete battery as fitted to a vehicle shall consist of one or more self-contained units connected in series or parallel as necessary. Each unit shall consist of a number of individual cells assembled into a tray.

4.2 Cell Container

Cell containers and lids shall be preferably of polypropylene or any other suitable light weight material.

4.3 Venting Device

The venting device shall be of anti-splash type and shall allow the gases to escape freely but shall effectively prevent acid particles or spray from coming out. Provision shall be made for drawing electrolyte samples, checking and servicing of the electrolyte.

4.4 Sealing

The arrangements for sealing between the lid and the cell box, and between the terminal posts and the lid, shall be such as to prevent any leakage of electrolyte in service. Sealing compound, if bitumen based, shall coform to IS 3116 : 1965. Heat sealing is preferred.

4.5 Tray

The colour of the tray shall be black, blue or red as per the agreement between the supplier and the customer.

The tray will be designed to carry the battery weight during lifting and to withstand jerks and vibration encountered on a road vehicle.

A locking groove will be provided in the tray to fix battery to the vehicle. However this is optional and may be changed or removed as per customers requirement.

4.6 Cell Connectors

Intercell connectors burned to the terminal posts connectors shall be either of lead or suitably lead coated copper. The coating of lead shall be adequate and tenacious, but not less than 0·06 mm thick connector should be suitable for minimum of 2 hour discharge rate.

4.7 Connections

The connections from the end terminals of each of 6 volt unit to the adjacent unit or to the external circuit shall be made of flexible insulated cable.

4.8 End Terminal Posts and Connectors

They shall be fitted with a thimble of IS 5154 : 1980. Tapered thimble shall be as shown in Fig. 1.

Tapered thimble shall be made of copper and coated with lead to a thickness of not less than 0·06 mm. The flexible wire shall be crimped to the thimble as soldered connections are not suitable on road vehicles due to high vibration and jerks.

4.9 Weight and Size of 6 V Unit

Recommended weight and size of each unit shall be as low as possible but shall not exceed those specified in Annex D (for the purpose of guidance only).

4.9.1 The weight and volume densities of each battery shall be min 30 Wh/kg and 75 Wh/dm^3.

4.10 Electrolyte

Battery grade sulphuric acid conforming to IS 266 : 1977 shall be used for preparation of electrolyte. After a full charge the specific gravity and temperature of the electrolyte shall be measured and the specific gravity corrected to 27°C.

4.11 Water

Water conforming to IS 1069 : 1964 shall be used in the preparation of electrolyte and to bring the electrolyte level to approximately the correct height during the course of testing and operation.

5 RATING

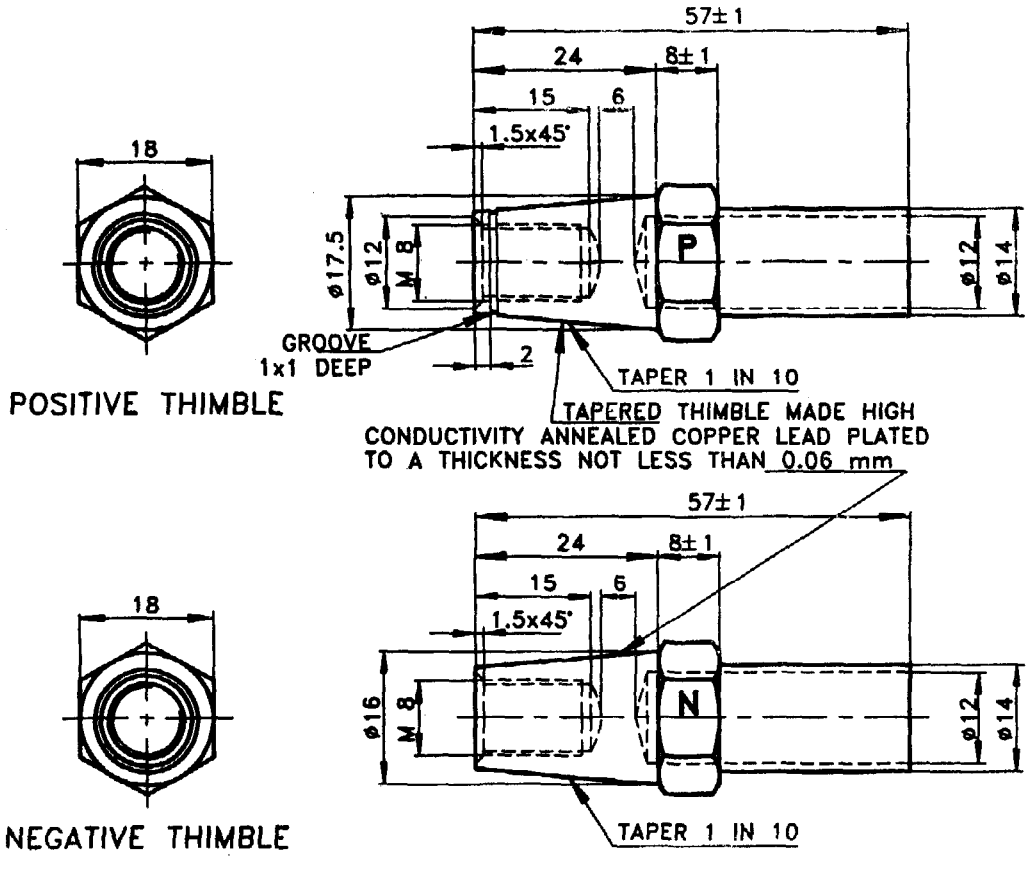
5.1 Rated Capacity

The rated capacity C5 assigned to the cell or battery by the manufacturer shall be the capacity expressed in ampere hours (after correction to 30°C) obtainable when the battery or cell is discharged at the 5-hour rate to a final voltage of 1·70 V per cell or $n \times 1{\cdot}70$ V per battery having n No. of cells of monobloc batteries with through partition connection under conditions of test specified in **8.10**.

5.2 Nominal Voltage

The following shall be preferred nominal voltage of the high energy density batteries for electric road vehicles:

12, 24, 48, 60, 96, 120, 144



All dimensions in millimetres.

FIG. 1 COPPER TAPERED CABLE THIMBLE

NOTE — Voltages other than those mentioned above shall be subjected to agreement between the manufacturer and the purchaser.

6 DIMENSIONS OF CELLS

6.1 The recommended dimensions of the cells are given in **4.9** and Table 1.

7 MARKING

7.1 The marking shall be clearly and permanently marked with the information given under (a) to (c). If the cells are supplied loose, the marking shall be on each cell and if 6-volt units are supplied, then the marking on each 6-volt is adequate:

a) Indication of source of manufacture,
b) The nominal voltage and rated capacity of the battery,
c) Country of origin, and
d) Month and year of manufacture.

7.1.1 The following information shall be given on the instruction cards supplied with the cells or batteries:

a) Instructions for filling and first charging of the cell, and
b) Maintenance instructions including charging rates.

7.2 The cells and batteries may also be marked with the Standard Mark.

8 TESTS

8.1 Classification of Tests

8.1.1 *Type Tests*

The tests specified in **8.1.1.1** shall constitute the type tests.

Table 1

(*Clause* 6.1)

Sl No.	Vehicle Type	Vehicle Requirement	Cell Data				
			Type	Quantity	Charging Current		
					2·1 V (12 h)	2·1 V (8 h)	2·5 V (gas)
1	G 1000	48 V, 219 AH	BYL 13	24	30·5	44·0	18·0
2	C 5000	48 V, 292 AH	BYL 17	24	41·0	58·5	24·0
3	D 10	72 V, 329 AH	HXM 15	36	46·0	66·0	27·5
4	K 11	72 V, 441 AH	JVN 15	36	61·5	88·0	36·5
5	KP 2/3	48 V, 329 AH	HXM 15	24	46·0	66·0	27·5
6	KP 7/8	60 V, 329 AH	HXM 15	30	46·0	66·0	27·5
7	Electron	72 V, 378 AH	HXM 17	36	52·5	75·0	31·0
8	Commodore	72 V, 423 AH	HXM 19	36	59·0	84·5	35·0
9	Majastic 96	96 V, 486 AH	IUN 19	48	68·0	97·0	40·5
10	Majastic 120	120 V, 420 AH	—	60	59·0	84·0	35·0
11	Sev 50	120 V, 184 AH	—	60	25·7	36·8	15·3

Charging time : 8 hours/12 hours.

8.1.1.1 *Sequence of tests and samples*

Four samples of cells shall be drawn at random by the testing or inspecting authority. The sequence of tests shall be as indicated in the schedule given below:

Tests	*Cell Number*			
	1	2	3	4
a) Visual examination (**8.6**)	×	×	×	×
b) Checking of dimensions (**8.7**)	×	×	×	×
c) Test for materials and components (**8.8**)	×	×	×	×
d) Air pressure test (**8.9**)	×	×	×	×
e) Test for capacity (**8.10**)	×	×	×	×
f) Charge retention test (**8.11**)	×	×	×	×
g) High rate discharge performance test (**8.12**)	×	×	×	×
h) Cyclic endurance test (**8.13**)	×	×	×	×

8.1.1.2 If any of the samples fails in the relevant type test, the testing or inspecting authority may call fresh samples not exceeding twice the original number and subject them again to the test(s) in which failure occurred. If there is any failure in the retest(s) the type shall be considered as not complying with this standard.

8.1.2 *Acceptance Tests*

The following shall constitute the acceptance tests:

a) Visual examination (**8.6**),
b) Checking of dimensions (**8.8**),
c) Air pressure test (**8.9**), and
d) Test for capacity (**8.10**).

8.1.2.1 *Sampling scheme and criteria for acceptance*

The sampling scheme and criteria for acceptance of a lot shall be in accordance with **6.1.4** of IS 8320 : 1982.

8.1.3 The following shall constitute the routine tests:

a) Visual examination (**8.6**), and
b) Air pressure test (**8.9**).

8.2 Equipment for Tests

The voltmeters, ammeters, thermometers and hydrometers used for the test shall comply with the requirements of **6.2** of IS 8320 : 1982.

8.3 Temperature for Test

Unless otherwise specified, the temperature of electrolyte during test discharge shall be within the limits of 20°C and 35°C.

8.4 Specific Gravity

For the purpose of test requirements, the specific gravity of a fully charged cell corrected to 30°C, shall be 1·280 ± 0·005.

8.4.1 To correct the specific gravity reading to 30°C, the following formula shall be used:

$$SG_{30} = SG_t + 0{\cdot}000\,7\,(t - 30)$$

where

SG_{30} = specific gravity at 30°C,

SG_t = specific gravity at t°C, and

t = temperature of the electrolyte.

NOTE — This value of specific gravity is for test purposes only. For normal use, the service specific gravity recommended by the manufacturer shall be maintained.

8.5 First Charge

The cell or battery, if received in the dry uncharged conditions, shall be filled with the electrolyte and charged in accordance with the manufacturer's instructions.

8.6 Visual Examination

All components shall be visually examined to check conformity with the relevant requirements of **4.1** to **4.8** and **7**.

8.7 Checking of Dimensions

The dimensions of cell terminal posts and fittings shall be checked for conformity with the requirements of **4.9** and **6**.

8.8 Test for Materials and Components

The rubber or plastic containers, sealing compound, sulphuric acid and water shall be tested for conformity to various Indian Standards specified under **4.2, 4.4, 4.10** and **4.11** respectively.

8.9 Air Pressure Test

The sealing of each cell of the battery shall be checked by compressed air at a pressure equal to 70 cm of water. The volume of the tubes and auxiliary parts in connection with the cell shall not exceed 0·5 litre. The air pressure in the cell 15 seconds after the supply has been disconnected shall be noted.

8.9.1 *Requirement*

The air pressure shall not fall from 70 cm to below 67 cm of water at the end of 15 seconds.

8.10 Test for Capacity

8.10.1 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 **8.10.2** and **8.10.3**. The specific gravity and level of electrolyte shall be checked after the full charge and adjusted, if necessary.

8.10.2 The cell shall be discharged through a suitable variable resistance at a constant current I = 0·20 C5 A, until the terminal voltage falls to 1·70 V.

8.10.3 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:

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.

8.10.4 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).

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

$$Ct\,°C = a \times 0{\cdot}20\,C5$$

where

a = discharge duration in hours,

t°C = average value of the initial and final electrolyte temperature, and

$C5$ = manufacturer's rating in Ah.

8.10.6 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 correated to 30°C by using the following formula:

$$C30°C = \frac{Ct}{1 + 0{\cdot}008\,(t - 30)}$$

The figure 0·008 represents the temperature-coefficient of variation of capacity of 0·8 percent per °C.

8.10.7 *Requirement*

On the first discharge the cell shall give not less than 85 percent of the rated capacity $C5$

and the rated capacity shall be reached in ten discharges subsequent to the initial charge. If as a result of the first test itself the capacity is found to be equal to or above the rated value, it is not necessary to carry out further tests.

8.11 Charge Retention Test

8.11.1 After having undergone a capacity test in accordance with **8.10** and having obtained a capacity, its surface shall be cleaned and dried in order to remove any traces of conductive material or electrolyte.

8.11.2 The battery shall be stored on open circuit (that is without a connected electric load) at an average electrolyte temperature of 27 ± 2°C for a period of 28 days (672 h).

8.11.3 At the end of the open circuit storage, in accordance with **8.11.2** the temperature of the electrolyte is adjusted to the range indicated in **8.10.5** and **8.10.6**. Then the residual capacity C_r shall be determined by a discharge at the current in accordance with **8.10.2** and thereafter in accordance with **8.10.4**.

8.11.4 The residual capacity C_r shall be not less than 0·80 rated capacity.

8.11.5 After the test, the battery shall be fully recharged in accordance with **8.10.1**.

8.12 High-Rate Discharge Performance Test

8.12.1 The test to verify the high-rate performance value (I_h) shall be carried out on a new battery the rated capacity of which has been developed, if necessary = by repeated discharge/charge cycles to 100 percent of reference capacity value fixed by the manufacturer which is valid for the temperature of 30°C, a discharge time of 5 h and a cut-off voltage of 1·70 per cell.

8.12.2 The initial electrolyte temperature of the battery and the ambient temperature shall be in accordance with **8.10.**

8.12.3 Within 1 h to 24 h after the end of charging, the battery shall be subjected to a discharge at the current I_h specified by the manufacturer.

The average discharge current shall correspond to I_h ± 1 percent. Current deviation shall not exceed ± 5 percent of I_h at any time. High rate discharge performance could be fixed percent of 5 hours capacity as min requirement.

8.12.4 The voltage across the terminals of the battery, excluding battery output cables, shall be either recorded automatically against time, or noted at suitable time intervals using a voltmeter.

NOTE — Truly to confirm the test conditions a voltage-time recorder may be specified to have correct value.

8.12.5 The average temperature of the t°C of electrolyte shall be measured and the discharge time T_h shall be calculated, according to the following equation:

$$T_h = 0{\cdot}5\ [\ 1 + 0{\cdot}008\ (\ t° - 30\ )\ ]\ \text{hours}$$

8.12.6 The cells or batteries shall then be discharged for a period of T_h hours when the final average voltage per cell shall be not less than 1·50 V.

Should, however, the voltage of 1·50 V per cell be reached prior to discharge I_h, the current may be interrupted. In this latter case, the cells or batteries on discharge have failed this test.

8.12.7 After the test, the battery shall be fully recharged in accordance with **8.10.1.**

8.13 Cycle Endurance Test

8.13.1 The test shall be carried out on minimum of three cells of the same type since it is a destructive test. Suitable packings should be provided for the test samples in order to maintain the same dimensions as when installed in batteries.

8.13.2 After undergoing the actual capacity test of **8.10** and having shown a rated capacity at least equal to the rated capacity declared reference capacity by the manufacturer (C_n), the cells shall be recharged as specified in **8.10.1.**

8.13.3 The cells shall then be connected to a device where they shall undergo a continuous series of cycles throughout the test, each cycle comprising:

a) a discharge for 3 h at a current of $I + C_n/4$ (A).

b) a recharge for 9 h immediately following the discharge supplying the battery with a charge of 0·864 C_H (AH), the current at the end of the charge being not greater than 0·3 I_n (A) where I_n is the rated current declared by the manufacturer.

Throughout the whole test, the temperature of the electrolyte shall be maintained between 33°C and 43°C.

8.13.4 After each series of 50 ± 5 cycles, the cells shall undergo a capacity test as specified in **8.10**.

The test shall be considered as terminated when the corrected capacity as in **8.10** resulting from this test is less than 0·8 C_N (Ah) during two successive series of 50 ± 5 cycles each.

8.13.5 The endurance in cycles is the number of cycles, completed up to the end of the first of the two final series. This number shall be at least equal to the number stated by the manufacturer.

8.13.6 A life of 1 200 cycles (*Min*) is required.

8.14 Vibration Test

This test is to determine the ability of a battery to withstand vibration forces without suffering mechanical damage, loss of capacity or electolyte or without developing internal or external leaks.

8.14.1 Four sample cells shall be subjected to this test. This test shall be carried out after the capacity test is done on the cells. Test to be carried out at temperature of 27 ± 3°C.

8.14.2 Place the cells on vibration machine, with the battery plates parallel to the axis of the rotating shaft of the machine.

8.14.3 The cells shall be firmly held down in a fashion similar to that experienced on the vehicle.

8.14.4 The electrolyte shall be at the level recommended by the manufacturer.

8.14.5 The batteries shall be vibrated for minimum 2 hours at an acceleration of 3 g (24 m/sec) and a frequency of 30-35 H_z. Each 2 hours of vibration shall represent unit of vibration.

8.14.6 During vibration test there shall be no electrolyte loss.

8.14.7 Immediately discharge the battery at (27 ± 3°C) at the rate of I=0·2 $C5$. The battery should show the rated capacity.

8.14.8 The battery shall be rated at the number of units it can service while meeting the requirements of the above test and on external and internal examination shall have no mechanical defects or leaks.

8.15 Short Circuit Test

A serviceable battery shall be held at 27°C ± 2°C for not less than 16 hours and not more than 24 hours. It shall then be connected to a test circuit with an appropriate matering connector for 60 seconds the total resistance of the circuit shall not exceed 2 mΩ. The current and the thermal voltage shall be measured throughout the test. After the test, there shall be no undue distortion of the battery case or components.

After normal servicing and recharging the battery shall be serviceable and shall be discharged at 1 C_{1a} at an ambient temperature 27 + 2°C to an end voltage corresponding to a mean voltage per cell of 1·67 V.

The discharge duration shall not be less than 1 hour.

ANNEX A

(*Foreword*)

SCHEDULE OF DESIGN PARTICULARS

A-1 The following particulars are required to be supplied by the manufacturer with the quotation.

Sl No.	*Description*	*Particulars to be Filled in*
i)	Make	.....
ii)	Type of unit	.....
iii)	Manufacturer's nomenclature	.....
iv)	Overall dimensions of unit (length × width × height)	.....
v)	Mass per unit with acid	.....
vi)	Cell container material	.....
vii)	Type of positive plates	.....
viii)	Type of negative plates	.....
ix)	Separators	.....
x)	Maximum electrolyte temperature test the cell battery withstands without any damage:	
	a) continuously	.....
	b) for a short period	.....
xi)	Electrolyte height above the top of the separators	.....
xii)	Quantity of electrolyte per cell	.....
xiii)	Specific gravity of electrolyte for initial filling at 27°C	.....
xiv)	Details of initial treatment recommended	.....
xv)	Material of terminal and intercell connectors	.....
xvi)	Normal charging rate	.....
xvii)	Charge and discharge characteristics	.....
xviii)	Internal resistance of cell	.....
xix)	a) Energy density of cell at 5 hour rate	.....
	b) Energy density of complete cell at 1 hour rate	.....
xx)	a) Power density of cell at 1 hour rate	.....
	b) Power density of cell at 1 minute rate	.....

ANNEX B

(*Foreword*)

SCHEDULE OF PERFORMANCE

B-1 The schedule of performance as given under shall be followed:

Sl No.	*Description*	*Particulars to be Filled*
i)	Batteries offered according to this standrad shall be covered by a type approval certificate from an appropriate authority. All variations in design shall be covered by a separate type approval certificate. Following particulars regarding the type tests shall be supplied by the manufacturer along with the certificate against any quotation or tender.	
ii)	Ampere-hour capacity	.....ampere-hour
iii)	Retention of charge	..... percent
iv)	Life (cyclic endurance test)	.....cycles
v)	Rise in electrolyte temperature above the ambient air temperature when charged from fully discharged to fully charged condition at normal rate	.....°C
vi)	Charge and discharge curves with voltage versus time showing the performance of the cell for discharge at 2-hour rate, and normal rate	.....
vii)	Recommendations for a reasonable fast charging method without effecting the manufacturer's guarantee	

ANNEX C

(*Foreword*)

AUTOMATIC BATTERY CHARGER

C-1 These specifications generally describe the automatic battery chargers meant for use with electric road vehicles.

C-2 The vehicles and battery data are given in Table 1.

C-3 The chargers shall be designed for operation with an input supply voltage variation of +6 percent to −10 percent and a frequency variation of +5 percent.

C-4 The chargers shall be designed for operation in tropical humid climate for a maximum ambient temperature of 45°C. The mean monthly relative humidity of 90 percent shall also be taken into consideration. The charger shall be designed for operation at altitudes below 1 000 m and the equipment shall be climate-proofed in accordance with IS 3202 : 1965.

C-5 The chargers shall essentially consist of the following equipment:

a) Step down transformers
b) AC choke(s)
c) Diode bridge
d) AC contractor(s)
e) Incoming MCB
f) DC ammeter
g) Automatic control circuits and protective equipment
h) Indication lamps

C-6 The chargers shall be designed for total automatic operation and all protective features should be built-in so as to prevent any damage to the battery units. The automatic and protective circuits should include:

a) verifications of the correct battery type and correct battery polarity before commencement of charge.

b) monitoring the state of charge of the battery continuously during charging the catering for mains voltage fluctuations.

c) accurate detection of the gassing state.

d) fail-safe as well as self compensating control circuits to ensure that the amount of charge received by the battery takes into account the —

- depth of discharge,
- temperatures, and
- life of the battery.

The charging process should be terminated only when the battery has received sufficient charge, with the provision of automatically terminating the charge, if even after six hours after detection of the gassing state, the battery condition does not stabilize.

e) power failure protection which should prevent overcharging if the charging process is interrupted by mains power failure.

f) refreshing charge provision which should make it possible to leave the battery connected to the charger indefinitely without the danger of overcharging. After the battery has been fully charged, the charger should deliver refreshing charge to the battery (to account for normal off-load discharges) of 10 minutes duration every 6 hours.

g) protection against inadvertant disconnection of the battery during charging and prevention of the output terminal being life if the battery is not connected to the charger.

C-7 The automatic control circuits should be built from solid state components and designed for the worst case conditions to have a high MTBF. The control circuit should be built on a printed circuit board of fibreglass reinforced epoxy card. All external connections to the PCB should be through either plug in connectors or screw type terminals. Stabilized voltages required for operation of the circuits should be generated within the charger itself.

C-8 The automatic control circuit should be identical for all types of batteries with the provision for connecting an easily detachable unit to cater for different battery voltages/ currents.

C-9 In the event of any fault or malfunction, the charger should provide a suitable visual alarm which is not automatically reset by power supply failures.

C-10 The transformer and chokes should be designed for proper taper characteristics and should take into account variations that may occur in the power supply. The transformers and chokes should be of a dry type with class B insulation. Tappings should be provided at ± 5 percent and ± 10 percent for all chargers.

C-11 All chargers should be of a single taper variety only.

C-12 For each vehicle, two types of chargers should be quoted — one which would charge an 80 percent discharged battery in 12 hours and another that would take 8 hours.

C-13 Single phase as well as three-phase chargers should be offered for all applications (98 hours as well as 12 hours), except in cases where the AC mains current exceeds 30A, in which case only three-phase chargers need be offered. Single phase chargers should be designed for a nominal input voltage of 240 V while three-phase chargers for 415 V.

C-14 For each type of charger offered, the following details should be attached with the offer, failing which the offer is liable to be rejected:

a) transformer rating with P.V. impedance,

b) choke data,

c) AC contactor and AC MCB rating and makes,

d) diode bridge rating with PIV values for diodes,

e) range and type of DC ammeter (and shunt if required), and

f) cubical dimensions.

C-15 The charger should be enclosed in a self venilated, vermin proof, free standing sheet steel cubical. The cubical should have a provision for screw-type eye bolts for lifting purposes. The cubicals should be thoroughly degressed and smoothed before application of rust resistant primer coats and the finishing coats.

C-16 All cables used inside the cubical should be designed for use in the high temperatures that are likely to prevail within the enclosures. All power connections should be made through flexible silicon rubber insulated copper cables with PCP or CSP sheeting or equivalent.

ANNEX D

(*Clause* 4.9)

WEIGHT AND SIZE OF 6 V UNIT

Table 2

Application	Rating C5	Maximum Weight of 6 V Unit (Filled)	Limiting Dimension of 6 V Unit
2 Wheeler	70/75 AH	12 kg	Length — 175 mm Width — 170 mm Height — 240 mm
Car	Around 180 AH	30 kg	Length — 260 mm Width — 180 mm Height — 275 mm
LCV range vehicle	Around 300 AH	50 kg	i) Length — 450 mm Width — 175 mm Height — 375 mm ii) Length — 312 mm Width — 205 mm Height — 400 mm

NOTES

1 The height indicated is the overall height inclusive of terminal posts and lifting handles.

2 The weight of 6 V unit includes the weight of intercell connectors.

Standard Mark

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986* and the Rules and Regulations made thereunder. The Standard Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well defined system of inspection, testing and quality control which is devised and supervised by BIS and operated by the producer. Standard marked products are also continuously checked by BIS for conformity to that standard as a further safeguard. Details of conditions under which a licence for the use of the Standard Mark may be granted to manufacturers or producers may be obtained from the Bureau of Indian Standards.

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IS 13514 : 1992 LEAD ACID BATTERIES FOR ELECTRIC ROAD VEHICLES — SPECIFICATION

(*Page* 2, *clause* 4.8, *second paragraph*, *line* 1) — Substitute 'annealed brass' *for* 'copper'.

(*Page* 11, *Table* 2, *col* 4, *row* 5) — Substitute '200 mm' *for* '180 mm.

(*Page* 11, *Table* 2, *col* 4, *row* 8) — Substitute '200 mm' *for* '175 mm'.

(ETD 11)

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