



**DRAFT SPECIFICATION
OF
LOW MAINTENANCE LEAD ACID STATIONARY SECONDARY CELLS
FOR
S&T INSTALLATIONS**

Version 1.0

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Table of Contents

Para No.	Item	Page No.
0.	Foreword	7
1.0	Scope	7
2.0	Rating and Designation	8
3.0	Constructional Requirement	8-10
4.0	Marking and Packing	10
5.0	Instruction & Maintenance Manual	11
6.0	General Electrical Requirements	11
7.0	Tests	12-15
8.0	Maintenance Tools and Instructions	15
9.0	Drawings	15
10.0	Information to be Supplied by Purchaser	16
11.0	Sampling procedure for Acceptance Test	17

Abbreviations used

IRS	Indian Railway Specification (Approved)
RDSO/SPN	RDSO Specification (Tentative)
DC	Direct Current
IS	Indian Standard
LM	Low Maintenance
AH	Ampere hour

**Government of India
Ministry of Railways
(Railway Board)**

**INDIAN RAILWAY STANDARD
DRAFT SPECIFICATION
FOR
LOW MAINTENANCE LEAD ACID STATIONARY SECONDARY CELLS FOR S&T
INSTALLATIONS**

0. FOREWORD

- 0.1 This specification is issued under the fixed Serial No. **S 88** followed by the year of adoption as standard or in case of revision the year of latest revision.
- 0.2 This specification require reference to the following Indian Standards (IS) and Indian Railway Standards (IRS).
- | | |
|---------------|--|
| IS: 1651-1991 | Specification for stationary cells and batteries, lead acid type (with tubular positive plates). |
| IS: 3116-1965 | Sealing compound for Lead acid batteries |
| IS: 6071-1986 | Synthetic separators for Lead acid batteries. |
| IS: 1146-1984 | Hard rubber and plastic containers for Lead acid batteries. |
| IS: 266-1993 | Sulphuric Acid |
| IRS: S 23 | Electrical Signalling & Interlocking Equipment. |
| IS: 6848-1979 | Lead Acid batteries for Train Lightning & Air Conditioning Services |
| IS:1069-93 | Specification for Water for storage batteries. |
- 0.3 Whenever, in this specification, any of the above mentioned specification is referred by number only, without mentioning the year of issue, the latest issue of that specification is implied, otherwise the particular issue referred to is meant.
- 0.4 This specification is intended chiefly to cover the technical provisions and does not include all the necessary provisions of contract.
- 0.5 For the purpose of this specification, the terminology given in IRS: S 23 wherever applicable and IS: 1651-91 shall apply.

1. SCOPE

- 1.1 This specification lays down the requirements for low maintenance lead acid secondary stationary batteries (flooded electrolyte-tubular construction) for use in railway signalling and telecommunication applications. The battery shall be of low maintenance design such that it requires very less topping up in the actual service. Frequency of topping up shall be not earlier than 6 months.

- 1.2 The specification covers the general and performance requirements for low maintenance lead acid secondary stationary batteries along with technical requirements of individual components for 12 AH, 20 AH, 40 AH, 80 AH, 120 AH, 200 AH, 300 AH, 400AH & 500AH capacity cells.

2. **RATING AND DESIGNATION**

2.1 Ampere Hour Rating

The rating assigned to the cells shall be the capacity expressed in Ampere Hour (after correction to 27 deg.C) stated by the manufacturer to be obtainable when the cell is discharged at 10 hour rate (C10) to a final voltage of 1.85Volts.

2.2 Designation

The cell/Battery shall be designated as per clause 4.2 of IS: 1651-91 followed by LM for indicating low maintenance character of the batteries.

3. **CONSTRUCTIONAL REQUIREMENTS**

- 3.1 The low maintenance lead acid rechargeable stationary battery shall be made in standard sizes of 2V, 4V, 6V, 8V and 12V as required by the purchaser.

- 3.2 The positive plate shall be tubular. The negative plate shall be pasted type of lead alloy. The positive and negative plate shall have antimony content less than 3% with suitable ingredients in grid to minimise antimony transfer and water loss during charging.

- 3.2.1 Separator shall be micro porous rubber, PVC or any other material conforming to IS: 6071-1986. The volume porosity shall be not less than 35%.

- 3.3 The cells shall be provided with suitable electrolyte level indicators. Cell lid shall be sealed with the container in such a way that there is no leak. The material used for electrolyte level indicator shall be acid proof and shall not deteriorate during service.

- 3.3.1 The electrolyte height at the top of the separator shall be 40mm (minimum) to achieve low maintenance features for batteries above 120AH.

- 3.4 The dimensions of the 2V cell of various capacities shall be in accordance with table 1 of Clause 7.1 of IS: 1651 and that of monoblock cells shall be in accordance with the relevant IS specification.

3.5 Micro Porous Vent Plug

- 3.5.1 Vent plugs shall be placed and secured in position to minimise loss of water/acid by carry over and evaporation. The vent plug shall be of ceramic or any other suitable fire retardant material. The vent plug shall allow free movement of gases evolved during service and shall not permit electrolyte to come out of the surface of lid. On removal of vent plug for drawing of the electrolyte sample, servicing and checking of electrolyte shall be possible.

3.5.2

The material used for micro-porous vent plug shall have uniform porosity. It shall also be free from abnormalities such as crack, breakage, foreign matter, dent and shall conform to the following. The following tests shall be applicable on Micro-porous dome of the vent plug only and dome shall be taken out for this purpose.

i) Porosity of micro-porous filter shall be calculated as given below:

Weigh the sample in air (W1). Keep the sample in boiling water with few drops of wetting agent (Teepol) for 30 minutes. Weigh the sample in water (W2). Next weigh the wet sample outside water (W3). Calculate porosity as under:

$$\text{Porosity \%} = \frac{(W3-W2) - (W1-W2)}{(W3-W2)} \times 100$$

Its value shall be $35 \pm 5\%$

ii) Breaking strength: Shall not be brittle. To test this, a steel ball of 200 gm shall be dropped two times from a height of 400mm on the top and side of micro-porous dome.

iii) Acid resistance: Dry and weigh the (micro-porous body) dome (W1). Keep the dome in sulphuric acid of Sp. Gr. 1.3 at 40 deg. C for 100 hours. Remove it from acid, wash free of acid, dry and weigh (W2). Calculate the percentage loss as follows.

$$= \frac{(W1-W2)}{W1} \times 100$$

The loss of weight shall not be more than 0.5%.

iv) Permeability: The fully charged cell shall be fitted with vent plug and charged at 2.5 times of C10 rate for 4 hours. All sealed float guides shall be in position properly except the one where manometer with water is fitted. The cell shall not develop positive pressure of more than 2 mm of water column inside the cell when fitted with vent plug.

v) Plastic Component: Plastic component to which the micro-porous top is bonded shall be free from crack, flash, pin hole, air bubble, uneven shrinkage foreign particles etc and shall conform to the following:

Material:	ABS fire retardant or superior quality
Acid Resistance:	No perceptible change
Heat:	No deformation at 70 deg. C

The material shall be tested for fire retardant test in the manner given below:

The Microporous Dome of the vent plug shall be held in the Bunsen burner flame. The flame shall be applied for 30 seconds and removed for a similar period and then applied again for a period of 30 seconds and then removed again. The

specimen, when ignited, shall not continue to burn for more than 15 seconds after the flame has been finally removed.

3.5.3 Each cell shall have one micro porous vent-cum-sealed float guide for upto 80 AH cells and having Dome / filter made of ceramic or any other suitable fire retardant material meeting the requirement specified in cl. 3.5.

3.5.4 For 120 AH and above, each cell shall have one float guide sealed type and one vent -cum -filling plug as mentioned above.

3.6 Sealing Compound

Sealing compound, if bitumen based, shall conform to IS: 3116 – 1965 with latest amendments.

3.7 Service Condition

The batteries are intended for use in moist tropical climate in India where the maximum ambient temperature may reach 55°C and 45 °C in shade, the daily average maximum ambient reaching 35°C, with a relative humidity reaching up to 100%.

3.8 Terminal Posts

Positive and negative terminal posts shall be clearly and unmistakably identifiable and shall be leak proof.

3.9 Connectors

The battery connectors shall be of lead or lead coated copper. The thickness of the lead coating on copper connectors shall not be less than 0.025 mm.

3.10 Nuts and Bolts

Bolts and nuts for connecting the cells, shall be made of copper / brass and shall be effectively lead coated to prevent corrosion.

4. **MARKING AND PACKING**

4.1 Marking

The following information shall be indelibly and durably marked on the outside of the cell.

- a) Manufacturer's type and trade name followed by LM indicating the low maintenance feature.
- b) AH capacity at 10 hour rate.
- c) Upper and lower electrolyte level in case of transparent container.
- d) Year of manufacture.

Note: Sticker not permitted on cells.

- 4.1.1 A yellow band of 25 mm width shall be provided on both sides along with the width of the cell for easy identification of Low maintenance batteries.
- 4.1.2 The cell and batteries may also be marked with IRS certification mark.

4.2 Packing

Manufacturer shall be responsible for safe transportation of cells/battery, which should be packed and delivered in good condition to consignee at its depot. If there is any damage, manufacturer shall replace the damaged cell/battery free of cost.

5. **INSTRUCTION & MAINTENANCE MANUAL**

- 5.1 The manufacturer shall supply one copy of instruction and maintenance manual specifying the minimum maintenance required for the battery with each lot to the purchaser.
- 5.2 The following information shall be provided on the instruction cards:
- a) Designation of cell or battery (Cl. 2.2)
 - b) AH capacity
 - c) Nominal voltage
 - d) Manufacturer's instructions for filling, initial charging, etc.
 - e) Nominal and finishing charging rates.
 - f) Maintenance instructions.

6. **GENERAL ELECTRICAL REQUIREMENTS**

- 6.1 The batteries shall not release corrosive gases under normal conditions and shall perform satisfactorily up to ambient temperature of 55 deg. C.
- 6.2 The battery /cell shall have capacity not less than the declared capacity at C10 rate to end voltage 1.85 Volts per cell.
- 6.3 The batteries shall be supplied dry and uncharged
- The Ampere-hour efficiency measured as per Clause 12.9 of IS: 1651-91 shall not be less than 95%.
- 6.4 Loss of capacity on storage of fully charged battery for a period of 28 days shall not exceed 5%.
- 6.5 Batteries when subjected to life test in terms of Clause 7.10 shall give a minimum life of 1100 cycles.
- 6.6 No topping up of electrolyte shall be required before initial 350 cycles.
- 6.7 Undue sulphation shall not take place at the terminals of the batteries when kept in partially discharged state.

7. TESTS

7.1 Classification of tests.

7.1.1 Type tests

The following shall constitute type tests and shall be carried out in the given sequence:

- | | | |
|----|---|----------|
| a) | Verification of constructional requirements | Cl. 7.2 |
| b) | Verification of marking and packing | Cl. 7.3 |
| c) | Verification of dimensions | Cl. 7.4 |
| d) | Test of capacity | Cl. 7.5) |
| e) | Test for loss of capacity on storage | Cl. 7.6 |
| f) | Endurance test | Cl. 7.7 |
| g) | Ampere-hour and watt-hour efficiency test | Cl.7.8 |
| h) | Test for voltage during discharge | Cl. 7.9 |
| i) | Life test | Cl. 7.10 |
| j) | Storage Test | Cl. 7.11 |
| k) | Water Loss Test | Cl.7. 12 |
| l) | Equilibrium Float Current Test | Cl. 7.13 |
| m) | Sulphation test | Cl. 7.14 |
| n) | Air pressure test on containers consisting of finished cell / battery | Cl. 7.15 |

- 7.1.2 The manufacturer shall submit composition of the alloy at the time of type testing along with Battery manufacturer's test certificate supported with certificate from National / International test house.

For conducting type tests, 11 cells shall be chosen at random if any of the samples fails in the relevant type tests, the testing authority may call for fresh samples not exceeding twice the original number and subject them again to all the tests in which failure occurred. If there is any failure in any of the repeat test(s), the type shall be considered as not having passed the requirements of this standard. The sequence of type testing shall be as under:-

Test	Number of samples										
	1	2	3	4	5	6	7	8	9	10	11
Verification of construction requirement, marking/ packing and dimensions	√	√	√	√	√	√	√	√	√	√	√
Test for capacity	√	√	√	√	√	√					
Air pressure test										√	√
Storage test										√	√
Life test							√	√	√		
AH /WH efficiency test	√	√									
Loss of capacity test on storage	√	√									
Endurance test			√	√							
Test for voltage during discharge					√	√					
Loss of water					√	√					
Equilibrium float current					√	√					
Sulphation test					√	√					

7.1.3 The manufacturer shall submit two sets of drawing in A4 size listed below for approval while offering the cell for type testing.

7.1.4 **Acceptance test**

The following shall constitute the acceptance tests:

- | | |
|--|----------|
| a) Verification of marking and packing | Cl. 7.3 |
| b) Verification of dimensions | Cl. 7.4 |
| c) Test for capacity | Cl. 7.5 |
| d) Air pressure test | Cl. 7.15 |

The sampling scheme and criteria for the acceptance of the lot for various lot sizes is given in Annexure-A.

7.2 Verification of constructional requirements:

The cells /batteries shall meet the requirements specified under clause 3.

7.3 Verification of marking and packing:

The marking on the cells and their packing shall be in accordance with the requirements of clause 4.

7.4 Verification of dimensions:

The overall dimensions of cells of standard capacities shall conform to the requirements given in table 1 clause 7.1 of IS: 1651-91 for 2V cells.

7.5 Test for capacity:

This shall be carried out as per clause 12.5 of IS: 1651-91 on all the 7 samples.

7.6 Tests for loss of capacity on storage:

The test shall be carried out as per clause 12.7 of IS: 1651-91. The loss of capacity thus measured shall not be more than 5%. It shall be done on 2 cells.

7.7 Endurance test:

The test shall be carried out as per clause 12.8 of IS: 1651-91 and shall meet the requirements brought out in clause 12.8.4 of IS: 1651. It shall be done on 2 cells.

- 7.8 Ampere hour and Watt hour efficiency test:
- The test shall be carried out as per Clause 12.9 of IS: 1651-91 and the AH efficiency shall not be less than 95% and the watt hour efficiency shall not be less than 75%. It shall be done on 2 cells.
- 7.9 Test for Voltage during discharge:
- The test shall be carried out as per clause 12.10 of IS: 1651-91 and samples shall meet the requirements brought out in clause 12.10.1 of IS: 1651-91. It shall be done on 2 cells.
- 7.10 Life test
- 7.10.1 The test shall be carried out on 3 batteries / cells which have complied with the requirement for the rated capacity.
- 7.10.2 The battery / cells shall be discharged and charged continuously as follows:
- a) Discharged for 3 hours at a current $I = 0.083 \times C_{10}$ amps.
 - b) Charged for 5 hours at a current $I = 0.055 \times C_{10}$ amps.
- Test discharged at every 50th cycle.
Water bath temperature = 40 deg. C + / -3 deg. C.
- 7.10.3 Every 50th discharge after initial 350 cycles shall consist of a discharge at the 10 hour rate in accordance with provisions of IS: 1651-91. Prior to each tests discharge, an equalizing charge shall be given and the specific gravity of the electrolyte of all the cells adjusted in accordance with the specified value. The discharge shall be followed by a recharge at the normal charging rate specified by the manufacturer
- 7.10.4 In order to verify the life test requirements, a test discharge shall be made at 1100th cycle.
- 7.10.5 The life test shall be recorded as complete as soon as the capacity obtained when tested as per clause 7.5 fails to reach 80% of the rated capacity in ampere hour.
- 7.10.6 Batteries / cells when subjected to life test as above shall give a minimum life of 1100 cycles of charge and discharge.
- 7.11 Storage Test:
- 7.11.1 The cell/battery unit shall be capable of being stored unfilled for a period of 24 months from the date of sealing by inspecting authority. After storage for the specified period the battery unit shall be tested as per clause 7.5.
- 7.11.2 The capacity after 24 months, when tested as above shall be not less than $\pm 3\%$ of the obtained capacity.

7.12 Loss of Water Test

After fully charging the cell, it should be cleaned and dried. It should be weighed immediately but not exceeding one hour after drying with an accuracy of 0.05% or maximum least count of 50 gm for the balance used. Then all vent cum-filling plugs should be closed tightly and connected to constant voltage charger keeping the voltage $2.4 \pm 0.05V$ per cell for 21 days in water bath at the temperature of 50 ± 2 deg. C. Thereafter cell is removed from circuit and dried. After this it is weighed accurately.

The water loss shall not exceed 0.7-gm/Ah/ cell of the rated capacity.

7.13 Equilibrium Float Current Test

This test shall be conducted during the initial three days (72 hours) of water loss test. The cell under test shall be kept in water bath at 50 ± 2 deg. C. Charging voltage shall be $2.4 \pm 0.05V$ per cell. The float current shall be measured and recorded. It shall not be more than 3mA/AH of the obtained test capacity

7.14 Sulphation test:

On a fully charged battery

- a) Discharge at a rate of $0.0135 \times C10$ for a period of 24 hours.
- b) Leave the battery for 120 hours.
- c) Recharge at $0.056 \times C10$ for 4 hours followed by $0.0135 \times C10$ for 12 hours.
- d) Discharged at 120 hour rate (i.e. $0.0125 \times C10$ to an end voltage of 1.9V / cell). The battery shall give at least 108 hours.

7.15 Air pressure test:

- a) Air pressure test shall be conducted on at least two samples. Sealing of each cell of the battery shall be checked by compressed air at pressure equal to 700-mm height of water column.
- b) Requirement – The air pressure shall not fall below 670 mm of water column in 15 seconds after the air supplied to the cell is disconnected.

8 MAINTENANCE TOOLS AND INSTRUCTIONS

A wall mounting type "Tool Board" of suitable material and protected against acid fumes shall be supplied along with set of 12 nos. each battery. The tool board shall comprise:

- i) One Syringe for adding or taking out electrolyte from the cells.

- ii) One syringe type hydrometer of requisite range for measuring the specific gravity of electrolyte in the cells. This shall be provided with a graduated scale, one division of which representing at the most 0.005 unit of specific gravity with accuracy of calibration not less than 0.005 units of specific gravity.
- iii) One cell- testing-voltmeter, 0-3 V of accuracy, class 0.5 in accordance with IS: 1248-1968. The resistance of the Voltmeter shall be 1000 ohms/Volt.
- iv) One thermometer with an appropriate scale for measuring temperature of electrolyte. One division of the graduated scale of the thermometer shall represent at the most 1 deg. C, the accuracy of calibration being not less than 0.5 deg.C.

9

DRAWING

9.1

The manufacturer shall supply two sets of drawing in A4 size listed below for approval while offering the cell for type testing.

- a) Detail drawing with dimensions of front, top and side view of the cell.
- b) Details drawing of the container showing different sections with dimensions.
- c) Part drawings with sectional details of -
 - Terminal post (Positive and Negative)
 - Container lid
 - Pole (Positive and Negative)
 - Plates (Positive and Negative groups assembly)
 - Separator
 - Sealed float guide
 - Micro porous vent plug
 - Inter cell /unit and end cell connectors.
- d) General arrangements indicating connections from cell to cell.
- e) Any other drawings considered relevant.

10.

INFORMATION TO BE SUPPLIED BY THE PURCHASER

- i) Nominal voltage of the cell / battery (Cl. 3.1)
- ii) Capacity (in AH at the 10 hr. rate)
- iii) Transparent container (Polypropylene) / Hard rubber container.
- iv) Accessories and spares required if any.

* * * * *

Annexure-A**SAMPLING PROCEDURE FOR ACCEPTANCE TESTS****A.1 Lot**

- A.1.1 In the consignment, all the cells of the same rating manufactured from the same material under similar conditions of production shall be grouped together to constitute a lot.
- A.1.2 These cells in the sample shall be drawn from the lot a random. For the purpose of random selection, reference may be made to IS: 4905-1968.

A.2 Sample size and Criteria for Conformity

- A.2.1 The acceptance tests shall be conducted on minimum two samples up to a maximum of 1% of each type in a lot, the samples being drawn at random by the purchasing or inspecting authority as specified in Cl. 5.1.3.1. Appendix 'G' in Amendment No. 1 of IS 6848-79 latest.
- A.2.2 Criteria for Acceptance if any of the samples cells fail in any of the acceptance test, twice the original number of samples shall be taken and subjected to all the acceptance tests. If there is failure in retest, the lot may be rejected.

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