

Tele / Fax : 91-0522-2465739/2465717

Telegram : 'RAILMANAK', Lucknow

Email dir.pemetro@gmail.com



सत्यमेव जयते

भारत सरकार - रेल मंत्रालय  
अनुसंधान अभिकल्प और मानक संगठन  
लखनऊ - 226011

Government of India  
Ministry of Railways  
Research, Designs & Standards Organization,  
LUCKNOW - 226011

24<sup>th</sup> June 2016

No. EL/6.7.50

**Chief Electrical Engineer,**

- Eastern Railway, Fairlie Place, Kolkata - 700 001
- Northern Railway, Baroda House, New Delhi-110 001
- Central Railway, Parcel office, CST, Mumbai CST - 400 001
- Western Railway, Churchgate, Mumbai - 400 020
- Southern Railway, Park Town, Chennai - 600 003
- East Central Railway, Dighi, Distt- Vashali, Hajipur, Bihar-844 101
- East Coast Railway, Bhuvneshwar Orissa-751 016
- North Central Railway, Subedarganj, Allahabad-211033
- North Eastern Railway, Gorakhpur -273 001
- North Western Railway, Jaipur 302006
- Northeast Frontier Railway, Maligaon, Guwahati - 781 001
- Western Central Railway, HQR's Office, Annexe Building, Indra market, Jabalpur (M.P.) - 482001
- South Eastern Railway, Garden Reach, Kolkata - 700 043
- South Central Railway, Nilayam, Secunderabad - 500 371
- South Western Railway, New zonal Hq. Office, First floor, west block, Hubli 580 020
- South East Central Railway, Bilaspur-495004
- Konkan Railway, Belapur Bhawan, Sector-11, Belapur, Mumbai - 400 614
- Rail Coach Factory, Kapurthala-144 602
- Integral Coach Factory, Chennai-600 038
- Modern Coach Factory, Lalganj, Raibareilly-229 120

**मुख्य विद्युत इंजीनियर**

- पूर्व रेलवे, फेयरली प्लेस, कोलकाता - 700 001
- उत्तर रेलवे, बड़ौदा हाउस, नई दिल्ली - 110 001
- मध्य रेलवे, मुंबई सी एस टी - 400 001
- पश्चिम रेलवे, चर्चगेट, मुंबई- 400 020
- दक्षिण रेलवे, पार्क टाउन, चेन्नई - 600 003
- पूर्व मध्य रेलवे, हाजीपुर दिघी, जिला वैशाली, बिहार - 844 101
- पूर्व तट रेलवे, बी-2, रेल विहार, चन्द्रशेखरपुरा, भुवनेश्वर, 751 023 (उडीसा)
- उत्तर मध्य रेलवे, हेडक्वाटर, ब्लाक ऐ, सुबेदारगंज, इलाहाबाद - 211 033
- पूर्वोत्तर रेलवे, गोरखपुर - 273 001
- उत्तर पश्चिम रेलवे, जयपुर - 302 006
- पूर्वोत्तर सीमान्त रेलवे, मालीगांव, गुवाहाटी - 781 011
- पश्चिम मध्य रेलवे, जबलपुर - 482 001
- दक्षिण पूर्व रेलवे, गार्डेन रीच, कोलकाता - 700 043
- दक्षिण मध्य रेलवे, 7 तल, रेल निलायम सिकंदराबाद - 500 071
- दक्षिण पश्चिम रेलवे, 4 तल, श्री लक्ष्मी नारायण काम्पलेक्स, स्टेशन रोड हुबली - 580 020
- दक्षिण पूर्व मध्य रेलवे, बिलासपुर - 495 004
- कोकण रेलवे, रायगंड भवन, 8 तल, बेलापुर भवन, सेक्टर 11, पी0बी0 45, नवी मुम्बई 400 614
- आर0 सी0 एफ0, कपुरथला, 144 602 (पंजाब)
- आई0सी0एफ0, पेरमबुर, चेन्नई-600 038
- मार्डन कोच फैक्टरी, लालगंज, रायबरेली-229120, उत्तर प्रदेश

Sub.: Revised Specification No. RDSO/PE/SPEC/AC/0009-2014 (Rev. 2) for VRLA batteries.

RDSO has revised the Specification No. RDSO Spec. No. RDSO/PE/SPEC/AC/0009-2008 (Rev. 1) with Amendment No.1 for VRLA batteries.

In view of the above, a copy of revised Specification No. RDSO/PE/SPEC/AC/0009-2014 (Rev. 2) for VRLA batteries is enclosed herewith for reference and necessary action at your end. It is further informed that copy of specification is being emailed also.

The revised specification No. RDSO/PE/SPEC/AC/0009-2014 (Rev. 2) for VRLA batteries is also being incorporated in the RDSO's approved vendor directory effective from 01.07.2016.

Yours Sincerely,

(लीला घर सिंह यादव)

निदेशक/पी.ई. एवं बैट्री

कृते महानिदेशक/पी.एस. एवं ई.एम.यू.

Copy for information please

सचिव विद्युत/जी,  
रेलवे बोर्ड, रेल भवन,  
रेल मंत्रालय, नयी दिल्ली - 110 001

Kind Attn. Sh. Vinayak Garg, DEE(G)

7/6



सत्यमेव जयते

भारत सरकार  
रेल मंत्रालय

GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS

अनुसंधान अभिकल्प एवं मानक संगठन  
रेल मंत्रालय

RESEARCH DESIGNS AND STANDARDS ORGANISATION  
MINISTRY OF RAILWAYS

110 वोल्ट ट्रेन लाइटिंग, वातानुकूलित एवं एल.एच.बी यानों के लिये वाल्व रेगुलेटेड लेड एसिड बैटरीज की  
विशिष्टी

VALVE REGULATED LEAD ACID BATTERIES FOR 110V TRAIN-LIGHTING , AIR CONDITIONED  
AND LHB COACHES

संख्या RDSO/PE/SPEC/AC/0009-2014 (Rev.2)

No. RDSO/PE/SPEC/AC/0009-2014 (Rev.2)

SN	Date of Revision/ amendment	Revision/Am endment	Page/ClauseNo.	Remarks
1.	<u>10.06.2009</u>	<u>Rev1,Amdt-1</u>	4 of 21 Cl. 3.1	2V 650Ah VRLA cell included
2.	<u>01.1.2012</u>	<u>Rev1, Amdt. No.2</u>	Cl. 0.4(b) Cl 1.1 & Cl. 3.1 5.4.2 5.5.4&5.5.5.	Monoblock change from 18 to 19 for 120Ah Voltage setting of RRU/ERRU revised & tray detail added for 120 Ah VRLA cell. Test with 2% voltage ripple & regulation added. Also, conductance test included Renewal & acceptance test clause revised. Annexure 'C' revised for Vibration test on one sample.
3	<u>11.02.2014</u>	<u>Rev.2</u>	4 of 21/Cl. 3.1 8 of 21 Cl.5.5.4.1 (b) & 5.5.5.2(a) 12 of 21 Cl. 5.11.8 14 of 21 Cl. 5.16.2 14 of 21 Cl. 5.17.2.1	6V & 12V module added for 1100Ah cell Clause revised Requirement of life cycle test unit increased from 20 unit Requirement of Gas recombination Efficiency revised Density of ABS container revised

APPROVED

*Nasim*  
21.07.15

ED/PS & EMU

Prepared by: <i>S. S. S. S.</i> SSE/Elect.	Checked By: <i>Nasim</i> Director/PE & Metro
---	---

**SPECIFICATION FOR VALVE REGULATED LEAD ACID (VRLA) BATTERIES  
FOR 110V TRAIN-LIGHTING, AIR CONDITIONED AND LHB COACHES**

**0.0 FOREWORD:**

0.1 In 110V train lighting system, 6V, 120Ah capacity LMLA and Valve Regulated Lead Acid (VRLA) Batteries are used. For air conditioned coaches, 525 Ah & 800 Ah capacity LMLA Batteries and 1100Ah capacity VRLA Batteries are used.

0.2 The conventional LMLA Batteries have common problems of frequent topping up, cleaning, sulphation of terminal and leakages etc. To overcome these problems to a considerable low level, the VRLA Batteries have been developed. These are also known as sealed maintenance free (SMF) Batteries.

0.3 After gaining field experience on 110V coaches, fitted with these Valve Regulated Lead Acid (VRLA) Batteries for train lighting, air-conditioned coaches and interaction with the manufacturers and production units/Railways, this specification was revised to Rev-1 with the incorporation of 70 AH LHB Battery and subsequently amended as brought out in top sheet. The specification is again being revised to Rev-2 to enhance the life units of the Battery.

0.4 This specification covers the design development and manufacture of VRLA Batteries for 110V, TL&AC coaches as follows:-

Type of coaches	Rated Capacity 10 Hr rate 27°C	No. of monoblock	No. of sets/coach	No. of Battery box/set
SG/LHB non-AC coaches	120 Ah	19 monoblock Batteries of 6 Volt or 57 cell of 2 Volt	1set	Two/One
SG AC coaches	1100 Ah	56 Cell	1set	Two
SG AC coaches	650 Ah	56 Cell	2set	Two
LHB coaches	70 Ah	9 modules of 12 Volt	1set	One

0.5 The supplier shall furnish the information of performance as given in Annexure 'A' and 'B' as per the approved design while submitting the tenders

0.6 For preparation of the specification, the assistance has been taken from the following publications:-

SN	Specification
I.	RDSO Spec. No. RDSO/PE/SPEC/D/TL/0009-99 with Amendment No. 1&2
II.	IS : 266-1993 with latest amendment
III.	IS : 6848-1979 with latest amendment
IV.	IS : 1069-1993
V.	IS : 8320-2000
VI.	IS : 4905:1968 with latest amendment
VII.	IS : 1146 – 1981 with latest amendment
VIII.	IEC 61373 –2010
IX.	IS 191-2007

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--

**1.0 SCOPE:**

1.1 This specification covers the design, manufacture, method of testing and other requirements of VRLA Batteries to be used for train lighting / air conditioning / LHB application on passenger coaches having 110 V system. For train lighting, 120 Ah Batteries shall be used in conjunction with brushless alternators with suitable rectifier cum regulators of 4.5 KW capacity with nominal setting of  $128.5 \pm 0.5V$ , at 19.0 Amp (half load) and 1500 rev/min. 500Ah to 1100Ah Batteries shall be used in conjunction with two number of brush less alternators with suitable rectifier cum regulators of 18/22.75/25 KW capacity with nominal setting of 129 V, at half load and 1500 rev/min.

1.1.1 For 12 V, 70 Ah Battery used for LHB coaches, the auxiliary power required for charging is supplied by a charger capable of charging Batteries at constant voltage mode as required by the Battery. The current limit for charging the Battery shall be 20 Amps with the voltage setting at  $122.0 \pm 1.0V$ .

1.2 If proper maintenance practices and its related guidelines are followed, the expected life of Battery is 5 years from the date of commissioning.

**2.0 TERMINOLOGY:**

2.1 For the purpose of this standard in addition to definitions given in IS: 8320-2000, the following shall also apply.

2.2 Valve Regulated lead acid Battery: - A Battery, which requires no topping up under normal working conditions and minimal maintenance during service life of the Battery. It has self-operating safety valve, which normally does not open out during service, regulates pressure of gases generated inside during charging hence this Battery is termed as VRLA Battery.

2.3 Type test: - Test carried out to prove conformity with the requirement of this specification. These are intended to prove the general quality and design of a given type of Battery.

2.4 Full Charge: - It means the current drawn by the cell/Battery is reduced to lowest value when it reaches to full state of charge and three consecutive hourly readings of current remain constant.

2.5 Acceptance Test: - Test carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot.

2.5.1 Lot: - All Batteries of the same type, design and rating manufactured at the same factory during the same period using the same process and materials offered for inspection at one time shall constitute a lot.

2.6 Electrolyte: - Aqueous solution of sulphuric acid for ionic conduction and Electro-chemical reaction during passage of current through a cell.

2.7 Terminal Post (lug): -A post (lug) of a cell or Battery to which an external electrical circuit is connected.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

**3.0 OVERALL DIMENSIONS AND MASSES:**

**3.1** The maximum dimensions and weight of each module/tray shall not exceed the values as given in Table-1 for respective capacities of cell/Batteries:

**Table-1-MAXIMUM DIMENSIONS(mm) AND WEIGHTS(kg) OF MODULES/TRAY**

S N	Capacity at 27° C	Rate of Discharge	Over all Length	Over all Height	Over all width	Weight * (Module)
1	70Ah (12V Monoblock)	10Hr	352	178	170	26.5
2	120Ah (24/30v)***	10Hr	660	500	475	165.0
3	500Ah (6v)	10Hr	550	220	600	200
4	800Ah (6v)	10Hr	700	210	630	350
5	1100Ah** (6V/8V/10V/12V)	10Hr	880/1095/ 1095/1125	640 (Height of total module)	695	270/360/ 425/530
6	650Ah** (16V) (24V)	10Hr	875 1125	640 (Height of total module)	695	430 620

\* Efforts shall be made to minimize the weight to reduce the weight of the coach. For easy loading/unloading, it will be preferred that 24 V module for 650Ah is splitted in two parts.

\*\*fixing hole centre distance shall be kept for Length=810/821/1066 mm and for Width=629/534 mm

\*\*\*Fixing hole centre distance for length=565±5mm and for width=305±5mm shall be kept for 120 Ah Battery

**NOTE: -**

- No deviation in the above dimensions and weight shall normally be permitted.
- The design of cell modules/tray of different types namely 6V, 8V, 10V, 16V, 24V and 30V in two or three tier mounting arrangement shall be duly approved by RDSO. The approved design of these modules shall only be modified in consultation with RDSO with different mounting methods: -
  - In existing Battery boxes,
  - Directly in the under frame.
- Three or more cells shall be kept in M.S. tray / modules having outer wall minimum thickness of 2 mm for 120 Ah and 3 mm or above for 500Ah onwards capacity, with minimum 2 mm partition wall thickness. These shall have provision to bypass one or two cells or 6V monoblock in case of any defect. The 12V 70 Ah monoblock Batteries do not require any steel tray.
- These Battery modules/tray shall be able to retrofit into the existing Battery boxes provided in under frame of AC coaches without effecting major changes in the existing Battery box.
- First time, fitment report shall be obtained from ICF or RCF.

Prepared by SSE/Elect.	Checked By Director/PE & Metro
------------------------	--------------------------------

**3.2 TERMINAL POST AND CONNECTOR:**

3.2.1 Positive and Negative posts with copper / Brass insert shall be clearly and unambiguously identifiable. 1100 Ah cell shall be with four terminal designs.

3.2.2 The take off terminal (positive and negative) for connection with coach cable for a set shall be given one side. The tightening torque shall be  $12 \pm 1 \text{ Nm}$ .

3.3 The lug hole dia of cable shall suit to M8 size fasteners except 70 Ah Batteries for which M6 size stain less steel fasteners shall be used.

**3.4 CABLE CONNECTOR:**

3.4.1 The cable connectors of suitable size shall have lead coating on lugs to withstand any corrosive attack. The thickness of the lead coating shall not be less than 25 microns, the lead coating thickness shall be measured in accordance with Appendix- 'F' of IS: 6848-79 with Amendment No. 1, 2 & 3.

3.4.2 The cable used for connector shall be of elastomeric type with composition of class-6, table No.1 of RDSO approved make conforming to RDSO Specification No. Spec/E - 14/01 Part -I (Rev-II) -1993 or latest.

3.4.3 The voltage drop across the Battery / cell cable connectors used in the Battery bank shall be less than 15mV per connector at C10 rate. However efforts shall be made to minimise the voltage drop as low as possible.

3.4.4 Fire retardant, heat shrinkable transparent polyolefin sleeves shall be provided to cover the crimped joints. To prevent loose connection during service vibrations, good quality spring washers shall be used.

3.4.5 **NUTS, BOLTS AND WASHERS:** Nuts bolts and washers for connecting the cells shall be made of acid resistant stainless steel which does not require lead coating.

**3.5 CONTAINER AND LID:**

3.5.1 **PPCP CONTAINER:** The cells/Batteries shall be manufactured in PPCP/ABS (Acrylonitrile Butadiene Styrene) container.

3.5.1.1 Container shall have ribs on outer/inner surface and the lid shall have the ribs on inner / outer surface to ensure the adequate container strength with design margins. Ribs will have suitable radius of curvature.

3.5.1.2 The 70Ah container with lifting handle on container (instead of lid) and container for other rating shall have adequate strength and design margins to meet the actual field conditions / handling as prevalent over Indian Railways for which Battery manufacturers shall be wholly responsible notwithstanding the approval given by RDSO. The adequate measures shall also be taken by manufacturers to avoid more than 2% bulging of cells/ Batteries along shorter/longer sides of the cells / Battery without tray. Despite the above design measures taken by the manufacturers, if failures of cells / Batteries on account of the container / lid crack, are reported from the field, the manufacturers shall replace these cells / Batteries with new cells/Batteries free of cost within the warranty period. The design of container and lids shall generally conform to the following specifications for all types of Battery:

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

(1)	Material specification	PP-CP (Polypropylene Co-Polymer) FR V2 grade / ABS FRV2 grade
(2)	Outer wall thickness (Min.) of container without ribs.	3.0 mm ( Minimum)
(3)	Partition wall thickness(min) (if used)	Mono block 12V, 70Ah -1.8mm & 6V,120Ah, 2.2 mm

- 3.6 SEPERATOR:** The separators used shall be micro-porous glass or superior material having high acid absorption capabilities and shall be resistant to sulphuric acid with good insulating properties and very low resistance.
- 3.7 ELECTROLYTE:** - It shall be prepared from Battery grade sulphuric acid conforming to IS 266-1993 with latest amendment.
- 3.8 WATER:** - The water for electrolyte shall conform to IS: 1069 – 1993.
- 3.9 SAFETY VALVE:** The safety valve shall be made from suitable rubber material. This shall be explosion resistant self-resealing & pressure regulating type. This safety valve shall be such that it cannot be opened without proper tool.
- 4.0 SERVICE CONDITION:** The cells are required to work at ambient temperatures up to 55 Degree Centigrade and will be subjected to vibration and dust in service when installed in the Battery boxes suspended from the under frame of the coaches. The design and construction of cells shall be suitable to withstand the above service condition. The vibration level generally is 3g & 5g.
- 5.0 RATING:**
- 5.1 RATED CAPACITY:** - The rating assigned to the Battery shall be capacity (C10) in Ampere hour (after correction at 27 degree centigrade temperature) when the cell is discharged at 10 hr. rate to the end voltage of 1.75V per cell.
- 5.2 DECLARED CAPACITY:** - Since the declared C10 capacity of Battery is generally higher than the rated C10 capacity, the manufacturer shall advice the declared C10 capacity of the cell
- 5.3 OBTAINED CAPACITY:** - Obtained capacity is the capacity obtained during discharge of cell up to 1.75V at 10 hours rate of the rated capacity of cell. The variation between declared capacity and obtained capacity shall not be more than  $\pm$  3 percent.
- 5.4 TESTS AND PERFORMANCE:**
- 5.4.1** Classification of tests.
- 5.4.2 Type Tests:** – The following shall constitute the type tests. All these tests shall be started after 3 cycles of charge / discharge at 10 hour rate. These tests shall be conducted at 20-32 degree centigrade unless and otherwise specifically mentioned. The test equipment shall be equipped with 2% or above voltage ripple and regulation.
- a) Capacity at 10 hrs rate as per Cl. 5.6 of this specification.
- b) Capacity at 5 hrs rate as per Cl. 5.7 of this specification.

Prepared by  S. S. E. Elect.	Checked By  Director/PE & Metro
---	--

- c) Capacity at 3 hrs rate as per Cl. 5.8 of this specification.
- d) Watt-hour & Ampere-hour Efficiency test as per Cl. 5.9 of this specification
- e) Retention of charge and storage test as per clause 5.10 of this specification.
- f) Life test according to clause 5.11 of this specification. The number of life units shall be as per Clause 5.11.8. After completion of life cycle test the Battery shall be cut opened and examined to arrive at the reason for reduction in capacity.
- g) Recharge Capability test as per clause 5.12 of this spec.
- h) Loss of cell weight as per clause 5.13 of this specification.
- i) Equilibrium float current test as per clause 5.14 of this specification.
- j) Permissible discharge current as per clause 5.15 of this spec.
- k) Recombination efficiency test as per clause 5.16 of this spec.
- l) Material and component specification verification test as per clause 5.17 of this spec.
- m) Test on bolts & washers as per Clause 5.18
- n) Air pressure and leakage test as per clause 5.19 of this specification.
- o) Vibration test as per clause 5.20 of this specification.
- p) Internal resistance as per clause 5.21 of this specification
- q) Capacity (C10) at 0°C as per clause 5.22 of this specification
- r) Conductance measurement as per Cl.5.23.
- s) Checking of dimensions, mass, marking and workmanship as per clause 3.1 & 6.0 of this specification

**5.5 SEQUENCE OF TYPE TESTS:-** The Sequence of type tests and the number of samples required shall be in accordance with Annexure "C".

Note: The cell shall be covered by the type approval certificate from appropriate authority of RDSO. Separate type approval certificates shall cover significant variations in the design. The cell of new design shall be re prototype tested for which samples offered by the manufacturer shall be accepted.

**5.5.1** If any of the samples fails in the relevant type test, the testing authority may call for fresh samples not exceeding twice the original number of cells tested in that particular test and subject them again to the test (s) in which failure occurred. If there is any failure in the retest(s) the sample type shall be considered as not having passed the requirements of this standard.

**5.5.2 DURATION OF TYPE TEST:-** Type test as per clause 5.4.2 shall be completed within six months (Maximum) from the date of starting the type test except storage test which shall be started within six months (max.)

**5.5.3 INSPECTING AUTHORITY:-** The type test as per clause 5.4.2 on cells shall be conducted by the representative of RDSO/Lucknow, India at the works of manufacturers for which all the test facilities shall be made available by the manufacturers at their cost.

**5.5.4 RENEWAL OF TYPE TEST:-** After successful prototype testing and fulfilling requirements of specification, initial approval given by RDSO shall be valid for maximum two / three years. Before expiry of validity manufacturer shall apply for

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--



renewal of type test approval six month in advance. The renewal/revalidation shall be done as per work instruction of RDSO and the samples shall be drawn from mass production at random. In case of unsatisfactory performance of cells in field, retype testing either part or full can also be done earlier at the discretion of the approving authority. During renewal following information shall be provided by the manufacturer along with other requirement as advised to manufacture. However, ISO guidelines for Vendor Approval shall prevail in case of any discrepancies.

1. Any deviations from bill of material and QAP approved by RDSO earlier.
2. Implementation confirmation of modifications issued by RDSO, if any.
3. Addition / Deletion of Machinery and Plant.
4. Supply orders executed by the manufacturer in last 3 years. Following details should be covered for last 3 year supply.
  - a) PO No. / Date
  - b) Consignee and date of supply
  - c) Quantity
  - d) Rate (inclusive of all taxes)
  - e) Warranty failures reported (nature of failure and action taken).

5.5.4.1 Following tests as per clause shall be carried out on seven samples at any Government lab having data logging facility or at manufacturer's premises for renewal of approval. All cost of testing shall be borne by manufacturer:

- a) Ah and Wh Efficiency test as per clause 5.9
- b) \*C3 capacity discharge test as per clause 5.8
- c) Equilibrium float current as per clause 5.14.
- d) Recombination efficiency test as per clause 5.16
- e) Internal resistance as per clause 5.21
- f) Conductance measurement as per Cl.5.23.

\*C3 discharge test shall not vary more than  $\pm 4$  % from the value obtained during prototype testing subject to minimum 72% of C10 obtained(at 27°C) during the first C10 capacity discharge test (a). For above tests seven samples shall be picked up from any production lot at random. It shall be checked for dimension, mass, marking/workmanship and components verifications. RDSO representative shall witness the above tests or seal the sample for testing in govt. test house. The full report of testing shall be submitted to RDSO for evaluation as per specification. After successful completion of above renewal, type approval shall be reissued.

#### 5.5.5 ACCEPTANCE TESTS:

5.5.5.1 The acceptance tests shall be conducted by RDSO or RITES/ Consignee as per this clause. Manufacturers shall submit in-house C-5 discharge test results along with Open Circuit Voltage after recharge along with the inspection call.

5.5.5.2 The following tests shall be conducted as acceptance tests.

- a. Capacity at 5 hrs rate according to clause 5.7 of this specification. The Capacity obtained shall not have variation of more than  $\pm 4$  percent of the C5 capacity obtained (Average capacity at 27°C during prototype testing) subject to minimum capacity 83% of obtained C10 capacity at 27°C. The weight of formed cell shall not vary more

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

than  $\pm 3.5$  percent of the average weight obtained during prototype testing. In one lot weight of formed cells shall not vary more than  $\pm 3\%$ .

- b. Checking of dimensions, mass, markings and workmanship as per clause 3.1 & 6.0
- c. Valve test open/closed as per clause 5.17.5 except 12V, 70 Ah Batteries.

5.5.6 **SAMPLING SCHEME AND CRITERIA FOR ACCEPTANCE:** A recommended sampling scheme and criteria for the acceptance of the lot for various lot sizes is given in Appendix "D"

5.6 **TEST FOR CAPACITY AT 10 HRS. RATE:**

5.6.1 After standing on open circuit condition for not less than 12 hrs. and not more than 24 hrs. from the completion of a full charge, the cell shall be discharged through a suitable resistance at constant current  $I = 0.1 \times C_{10}$  amperes, and the discharge shall be stopped when the closed circuit voltage across the Battery terminals falls to 1.75 volts per cell.

5.6.2 At this rate of discharge, hourly voltage readings shall be taken until the cell voltage approaches 1.90 volts per cell after which the readings shall be taken every 15 minutes until the voltage falls to 1.75V / Cell.

5.6.3 The capacity in Ampere-hour shall be obtained by multiplying the discharge current by the total time of discharge in hours and the product so obtained shall be corrected to temperature of 27 °C by the following formula.

$$\text{The capacity at } 27^{\circ}\text{C} = \frac{CT}{1+K(t-27)} \text{ Ah}$$

Where CT is the capacity observed at t degree centigrade. K is correction factor 0.0043; t is the average of hourly room temperature in degree centigrade.

5.6.4 The capacity on the first discharge the Batteries or cells shall give within  $\pm 3$  percent of declared capacity.

5.6.5 The Battery shall be charged at the normal charging rate immediately after the discharge within 15 hrs. The charging of VRLA Batteries may be carried out for test purpose using constant potential charging method or constant current charging method as recommended by the manufacturer.



5.7 **TEST FOR CAPACITY AT 5 HRS RATE:**

5.7.1 After standing on open circuit condition for not less than 12 hrs. and not more than 24 hrs. from the completion of a full charge, the cell shall be discharged through a suitable resistance at constant current  $I = 0.2 \times C_5$  amperes, Where  $C_5 = 0.83 \times C_{10}$  and the discharge shall be stopped when the closed circuit voltage across the terminals falls to 1.75 Volts/ cell.

5.7.2 At this rate of discharge, hourly voltage readings shall be taken until the cell voltage approaches 1.90 volts per cell after which the readings shall be taken every 15 minutes until the voltage falls to 1.75V / Cell.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--

- 5.7.3 The capacity in ampere-hour shall be obtained by multiplying the discharge current by the total time of discharge in hours and the product so obtained shall be corrected to a temperature of 27°C by the formula referred in clause 5.6.3 using the values for correction factor K is 0.0084 for pasted plate.
- 5.7.4 Capacity at 5 hrs. rate shall not be less than 83% of obtained capacity.
- 5.7.4.1 The Battery shall be charged at the normal charging rate immediately after the discharge within 15 hrs.
- 5.8 TEST FOR CAPACITY AT 3 HR. RATE:**
- 5.8.1 After standing on open circuit condition for not less than 12 hrs. and not more than 24 hrs. from the completion of a full charge, the cell shall be discharged through a suitable resistance at constant current  $I = 0.33 \times C3$  amperes, Where  $C3 = 0.72 \times C10$  and the discharge shall be stopped when the closed circuit voltage across the terminals falls to 1.70 volts per cell.
- 5.8.2 At this rate of discharge, hourly voltage readings shall be taken until the Battery voltage approaches 1.90 volts per cell after which the readings shall be taken every 15 minutes until the voltage falls to 1.70V/Cell.
- 5.8.3 The capacity in Ampere hour shall be obtained by multiplying the discharge current by the total time of discharge in hours and the product so obtained shall be corrected to a temperature of 27 deg. C by the formula referred in clause 5.6.3 using the value for correction factor k is 0.0091 for pasted plates.
- 5.8.4 The C3 Capacity shall not be less than 72% of obtained capacity.
- 5.8.5 The Battery shall be charged at the normal charging rate immediately after the discharge within 15 hrs.
- 5.9 WATT-HOUR AND AMPERE –HOUR EFFICIENCY TEST:**
- 5.9.1 Ampere-hour efficiency: Full charged Battery shall be subjected to discharge at  $I=0.1 \times C10$  Amp. to end voltage of 1.75V/cell. Careful measurements are made of ampere-hours delivered. On recharge, the same number of Ampere-hours is put back. The second discharge shall be made to the same end voltage as before. The efficiency of the Battery is then calculated as the ratio of the Ampere hours delivered during second discharge to the Ampere-hours put back on recharge.
- 5.9.2 Watt-hour efficiency: The watt-hour efficiency shall be calculated by multiplying the Ampere-hour efficiency by ratio of average discharge and recharge voltage. The values of discharge and recharge voltages shall be calculated from the log sheet for Ampere-hour efficiency.
- 5.9.3 Watt-hour and Ampere-hour efficiency when tested and calculated shall not be less than 84 percent and 96 percent respectively. During the test rest period of 12hrs to 24hrs shall be given between each charge/discharge.
- 5.9.4 Watt Hour and Ampere Hour efficiency shall be checked every six months by the manufacturer and record shall be kept. This must be mentioned in the QAP. Records shall be verified by RDSO.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

**5.10 TEST FOR RETENTION OF CHARGE AND STORAGE TEST:**

- 5.10.1 The object of this test is to determine the loss of capacity of a cell in open circuit during a specified period.
- 5.10.2 The cell shall be fully charged at the normal charging rate specified by the manufacturer and it shall then be subjected to two consecutive capacity test discharges in accordance with clause 5.6, the value of the initial capacity 'C' being calculated as the mean of the two results thus obtained.
- 5.10.3 After a complete recharge, the cell shall be stored for a period of 180 days (six months) at a temp. of  $27 \pm 5^\circ\text{C}$ .
- 5.10.4 After six months of storage the cell shall be discharged in accordance with clause 5.6. The value of the capacity measured after storage shall be denoted by C1.
- 5.10.5 After the discharge the cell shall be charged at the normal charging rate at C10 rate.
- 5.10.6 The loss of capacity 'S' expressed, as percentage shall be calculated by the formula.

$$S = \frac{C - C1}{C} \times 100$$


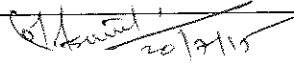
- 5.10.7 Requirement: The loss of capacity calculated as in 5.10.6 shall not be more than 10% over 180 days (six months) storage period.

**5.11 LIFE TEST:**

- 5.11.1 The life of Battery is defined by the number of life test units obtained under the following conditions.
- 5.11.2 The life test is carried out on at least two cells, which have satisfactorily passed the tests in accordance with clause 3.1, 5.6 and 6.0
- 5.11.3 **Original Test Capacity:**
- 5.11.3.1 The cells shall be kept in a water bath or suitable hot chamber and providing with chart recorder or life cycle tester which is maintained at  $50 \pm 2^\circ\text{C}$ . A minimum gap between the cells and the sides of water bath shall be 25mm. The cells shall be so immersed in vertical direction that the top of the cell is 25mm above water level in the tank.
- 5.11.3.2 After standing in open circuit for not less than 12 hours but not more than 24 hours from the completion of a full charge the Battery shall be discharge through a suitable resistance at a constant current  $I = 0.10 \times C10$  Amp and discharge shall be completed when the closed circuit voltage across the Battery terminal falls to 1.75V per cell.
- 5.11.3.3 The capacity in Ah shall be obtained by multiplying the discharge current by the total time of discharge in hours. This capacity shall be called as original test capacity (OTC)
- 5.11.4 During these tests Battery shall be subjected to a series of discharges and charges continuously.

Prepared by SSE/Elect.	Checked By Director/PE & Metro
------------------------	--------------------------------

- 5.11.5 The discharge shall be for 4 hours or to 1.75V per cell at a current of 0.25 C10 Amp. This shall be followed by charge at a constant voltage of 2.3V per cell with a maximum current limit of 20 percent of the rated capacity for 20 hours. The charge and discharge cycle shall be carried out five times.
- 5.11.6 After above cycles of discharges and charges the Battery shall be kept on open circuit for 12 hours at  $50 \pm 2^\circ\text{C}$ . After this open circuit stand, they shall be test discharged at the rate of  $I = 0.1 \times C10$  Amp. The discharge is continued to an end voltage of 1.75V per cell.
- 5.11.7 On completion of this discharge the Batteries shall be fully recharged. The combination of discharge and recharge cycles as described above together with 12 hours open circuit stand period, the test discharge and subsequent recharge shall be one unit of life test.
- 5.11.8 The Batteries shall be subjected to repeated test units described in clause 5.11.5, 5.11.6 and 5.11.7 until capacity measured in any test discharge falls to 80% of original test capacity (OTC) clause 5.11.3.3. The number of life units the Battery has yielded shall not be less than 24 units for 1100Ah & 650Ah VRLA Batteries and 22 units for others.
- 5.12 RECHARGE CAPABILITY TEST:**
- 5.12.1 The object of this test is to determine the recharge capability of the Battery after a specified period of storage at zero state of charge.
- 5.12.2 After standing on open circuit for not less than 12 hours and not more than 24 hours from completion of full charge, the Battery shall be discharged (as per Clause 5.6) through a suitable resistance at a constant current of  $I = 0.1 \times C10$  amp. The discharge shall be stopped when the closed circuit voltage across the Battery terminals falls to 1.5V per cell.
- 5.12.3 After complete of discharge, the Battery (having 1.50V) shall be left on open circuit for a period of 7 days in fully discharge condition without disturbance at a temperature of  $27 \pm 3^\circ\text{C}$ .
- 5.12.4 After 7 days storage (the above cells having end voltage 1.50V), the Battery shall be charged at the normal charging rate immediately.
- 5.12.5 After standing on open circuit for not less than 12 hours but not more than 24 hours from the completion of a full charge, the Battery shall be discharged at a rate of  $I = 0.1 \times C10$  Amp (as per Clause 5.6). The discharge is continued to an end voltage of 1.75V per cell.
- 5.12.6 Requirements: The obtained capacity shall not be less than 97% of initial capacity tested as per clause 5.12.2
- 5.13 LOSS OF CELL WEIGHT:** After fully charging the Battery 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 50gm 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 volt per cell, within the tolerance of  $\pm 0.05\text{V}$ , for 21 days in water bath or hot chamber at a temperature of  $55 \pm 2^\circ\text{C}$ . There-after cell is removed from circuit and dried. After this it is weighted accurately.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

5.13.1 The cell weight loss shall not exceed 0.05gm/Ah/cell of the obtained capacity and between two cells/Batteries, variation shall not be more than 5% i.e.  $\frac{[(\text{Max} - \text{Min})/\text{Max}] \times 100}{}$ .

**5.14 EQUILIBRIUM FLOAT CURRENT TEST:** The Battery under test shall be kept in water bath at  $55 \pm 2^\circ\text{C}$  and charging voltage shall be 2.4V per cell. The float current shall be measured and recorded. It shall not be more than 5mA/Ah of the rated capacity. This test shall be conducted during the initial three days (72hrs.) of the loss of cell weight test as per above clause 5.13.

**5.15 TEST FOR PERMISSIBLE DISCHARGE CURRENT:**

5.15.1 A fully charged Battery shall be used for test under either of the following conditions and checked by visual observation and measurement of voltage.

5.15.1.1 A fully charge Battery is allowed to rest for 12 to 24 hours at an ambient temp. of  $27 \pm 3^\circ\text{C}$  and subjected to either of the following two discharges (a&b for 70Ah and c&d for other batteries):

- a) For 8 minute at a constant current of 3 C10 amps.
- or
- b) For 2 minute at a constant current of 6 C10 amps.
- c) For 1 minute at a constant current of 3 C10 amps.
- or
- d) For 5 seconds at a constant current of 6 C10 amps.

5.15.2 During the test there shall be no melting of the terminals or severance of electrical continuity and there shall be no deformation in the outside appearance of the Battery.

**5.16 TEST FOR GAS RECOMBINATION EFFICIENCY:**

5.16.1 Gas recombination efficiency is measured using a fully charged Battery after it has completed a C10 discharge successfully, with the following conditions:

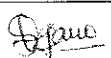
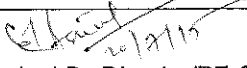
- i) The test Battery is continuously charged for 96 hours at a constant current of 0.01 C10 Amps.
- ii) Within 1hr of completion of charge as specified in (i) charge continuously at a constant current of 0.005 C10 Amps.
- iii) Gases coming out of the Battery are fully collected in a glass-jar by displacement of water, a suitable arrangement for which shall be provided.
- iv) Time for gas collection: 1 hour (during charge as ii)
- v) Calculation of recombination efficiency;  
From the measured volume of gas collected; volume of gas collected per cell under normal temperature and pressure condition is calculated as follows:  
$$V_n = P/P_o \times 298/(t+273) \times V/Q \times 1/n$$

Where,

$V_n$  = Normalized gas volume, ml/ah;

$V$  = measured gas volume, ml;

$P$  = measured ambient pressure, mm Hg;

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--

Po = Normal atmosphere pressure, 760 mm Hg;  
 T = Ambient temperature in degree centigrade;  
 Q = Ah of electricity passed during gas collection;  
 n = Number of cell from which gas is simultaneously collected.  
 Gas recombination efficiency is then calculated as:  
 Recombination efficiency (percent) =  $(1 - V_n/684) \times 100$

5.16.2 Gas recombination efficiency shall be 95% or more.

#### 5.17 MATERIAL AND COMPONENTS VERIFICATION TEST:

5.17.1 The cell shall be examined in the dismantled condition to see that the manufacturing is in the approved outline and assembly drawing and various components are conforming to the specification as declared by the manufacturer.

5.17.2 **CONTAINER & LID:** Containers shall conform the following tests as per clause 7 of IS: 1146-81.

- i) Verification of constructional requirements
- ii) Verification of marking and packing
- iii) High voltage test
- iv) Drop ball test\*
- v) Plastic yield test
- vi) Acid resistance test
- vii) Izod impact test

\*For drop ball test, the height at which container get crack shall not be less than 1000 mm (minimum single value)

5.17.2.1 The density of the material shall be  $0.95 \pm 0.04$  grams/cc for PPCP and  $1.13 \pm 0.04$  grams/cc for ABS at 25° C

5.17.3 **CHECKING OF ALLOY:** Firms shall furnish reports of alloy composition (spine & grid) checked by optical emission spectrometry (O.E.S.) or atomic absorption spectrometer (AAS).


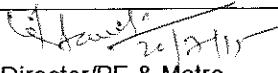
#### 5.17.4 SEPARATORS:

5.17.4.1 The uncompressed separator, electrolyte (Sp.Gr.1.250) absorption of the separator shall be at least 5gram of electrolyte (Sp.Gr.1.250) / gram of separators material.

5.17.4.2 The uncompressed separator sample from the separator box shall be cut to make it into one piece with the size of 1 inch width and 25 inches length.

5.17.4.3 The minimum electrolyte (Sp.Gr.1.250) content at 5 inches height from electrolyte level of the container shall be at least 5 gram of electrolyte/gram of separator. The electrolyte (Sp.Gr.1.250) shall conform to IS: 266-1993 latest editions and the temperature of the electrolyte shall be within  $27 \pm 3^\circ\text{C}$

5.17.4.5 The weight of electrolyte content/gram of separator shall be 75% Min. of the value obtained at 5 inch when checked at a height of 18 inch from the height of 5 inches.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

5.17.4.5 The total wicking height shall not be less than 25 inches in 6 hours

**5.17.5 SAFETY VALVE:**

5.17.5.1 The safety valve shall be explosion proof.

5.17.5.2 The vent shall release excess pressure between 2 and 7 PSI and shall reseal before the pressure drops to atmospheric pressure. Manufacturers shall declare open/closing pressure of one particular vent seal within the tolerance of  $\pm 8\%$  in PSI when tested repeatedly for 5 times. The variation between two vent seals for closing/opening pressure shall also not be more than  $15\% \left[ \frac{\text{Max} - \text{Min}}{\text{Max}} \times 100 \right]$  tolerance limit. Opening and closing pressure setting shall not overlap.

5.17.5.3 **SAFETY VALVE OPERATION:** In the safety valve function test, either valves themselves or valves as components of the Battery are tested by gradually increasing air pressure and the safety valve pressure is measured when valve opens, similarly, gradually reducing air pressure from the level of pressure that has caused the valves to open, the pressure when the valve is closed, is measured and shall pass the clause 5.17.5.2.

**5.18 NUTS, BOLTS AND WASHERS:** Nut, bolts and washers shall be stainless steel and shall be resistant to sulphuric acid.

5.18.2 Bolts and washers shall be tested by immersing in 1.300 Sp.gr. of sulphuric acid for not less than 72hrs; the acid shall be cleared at the end of this period. There shall not be any visible effect on the nuts, bolts & washers.

**5.19 AIR PRESSURE TEST:** This test shall be carried out on all cells and Batteries before filling acid to ensure the sealing strength and to check leakage in the cells.

5.19.1 To check the leakage and sealing strength in cell, compressed air at the pressure of 7 psi shall be applied for 1 minute. The cell lid shall not show any visible sign of movement due to the air pressure and drop in pressure due to leakage. To detect the leakage, cell shall be immersed in water bath.

Note: The air pressure test shall be done on 100% cells of PPCP/ABS at the pressure at 5-6 psi during production for 20 seconds.

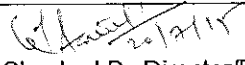
5.19.2 Any cell failing this test shall be rejected for further assembly.

**5.20 VIBRATION TEST:** The cell shall be subjected to vibration and shock testing as per IEC 61373 - 2010.

- a) Random vibration test as per clause 8 Table-1, category 1 Class B
- b) Simulated long life test as per clause 9, Table-2, category 1 Class B
- c) Shock test as per clause 10, Table-3, category 1 Class B

5.20.1 There shall be no leakage of electrolyte. C10 capacity test also shall be carried out prior to commencing and on completion of above tests. RDSO representative shall witness the capacity tests and it should be within 3% of capacity obtained.

5.20.2 If the testing facility is not available in house, manufacturer can carry out the test at any approved Govt. laboratory.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--



- 5.21 INTERNAL RESISTANCE OF CELLS:-** After charging and rest not exceeding 24 hour, the cell shall be discharged for one hour at 10 hr rate. The test shall be continued by increasing the discharge current to approximately equal to 75% of rated capacity i.e.  $A1=0.75 \times C10$  and after an interval not exceeding 5 minutes, the current shall be decreased to 25% of rated capacity i.e.  $A2=0.25 \times C10$ . The current  $A1$  and  $A2$  in amperes and the corresponding cell terminal voltage  $V1$  and  $V2$  in volts shall be measured. Accuracy of instruments used shall be 0.001V and 0.1Amp. The internal resistance in milli ohm of the cell shall be calculated by applying following formula.

$$R = \frac{V2 - V1}{A1 - A2} \times 1000 \text{ Milliohm}$$

- 5.21.1** The variation in internal resistance of two cells shall not be more than 10%  $\left[\frac{(\text{Max} - \text{Min})}{\text{Max}} \times 100\right]$ . For 12V 70Ah Batteries, the internal resistance of Batteries shall not be more than 8 milli-ohm and variation between two Batteries not exceed 10%  $\left[\frac{(\text{Max} - \text{Min})}{\text{Max}} \times 100\right]$ .
- 5.22 CAPACITY AT 0°C:** - The fully charged cell shall be stored for 12 to 24 hour at the temperature of  $0 \pm 1^\circ\text{C}$ . The cell then shall be discharged maintaining same temperature by current  $I=0.1 \times C10$  Amp. to a cut off voltage of 1.75V. The amp-hour capacity of cell shall be measured. The capacity shall not be less than 70% of obtained capacity.
- 5.23 CONDUCTANCE MEASUREMENT OF CELL:** The conductance of all Batteries/cells shall be measured with conductance meter and value shall be recorded. The variation between the Batteries/cells shall not exceed 10% with respect to maximum conductance value  $\left[\frac{(\text{Max} - \text{Min})}{\text{Max}} \times 100\right]$ .
- 5.24 TEST EQUIPMENTS:**
- 5.24.1** The voltmeters, Ammeters, Thermometers and hydrometers required for tests specified in this standard shall meet the requirements given in 11.2 of IS: 8320-2000. Where digital meters are used, the meter shall be capable of displaying up to two decimals in the range 0 to 99V and one decimal in 100 and above volts range. The digital meters shall be capable of displaying at least up to two decimal values.
- 5.24.2** All prototype tests shall be conducted by the computerized control Battery charging /discharging equipment with 2% or above voltage ripple & regulation and shall have monitoring & recording system of test parameters. Manually testing is not permitted. Life cycle testing is to be carried out through fully computerized control with continuous logging facility of time, voltage (minimum 6 chancels), current, temperature, Ah, Wh, Mode and cycle step.
- 5.24.3** The rest period before discharge shall be 12 to 24 hour, however in unavoidable circumstances if rest period exceeds to 24 hour, additional freshening charge shall be given before conducting the discharge test.
- 6.0 MARKING AND PACKING:**
- 6.1** Either the shorter or longer side of each of module, shell have the following details marked on it:
- a) Manufacturers name or trademark embossed on container lid.

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

- b) Manufacturers name; trademark and place of manufacturing and.  
c) Rating at 10hr. discharge rate.

Note: STICKER not permitted on steel modules.

- 6.1.1 The year and month (e.g. April 07 can be shown as 04/07) of manufacturer shall be hot punched of letter size not less than 6 mm on the lid. Marking shall also be done by acid proof paint on shorter side of containers and steel modules. Code wise date shall not be accepted.
- 6.1.1.1 Manufacturer name or trademark and rating of Battery will be impressed or embossed on the container or on lid in cells/Batteries if marking is not possible to be embossed on container
- 6.1.2 Manufacturer shall be responsible for safe transportation of Battery. Battery should be delivered in good condition to consignee at his depot/workshop. If there is any damage manufacturer shall replace the Battery free of cost.
- 7.0 **MANUAL OF INSTRUCTIONS:** The manufacturer shall supply one copy of instructions manual for routine maintenance and attention required during service, with every batch of Batteries supplied to the each consignee. Effort shall be made by firm to minimize maintenance by design improvement with intimation to RDSO. The instruction manual shall comply with RDSO's SMIs.
- 8.0 **WARRANTY:** The manufacturer shall declare the expected life under testing condition in type test offer as well as while submitting the technical details to RDSO.
- 8.1 The manufacturer shall replace all the failed cells with new cells of same design / type within the warranty period free of cost as per the term and conditions of the purchase order or the contract.
- 9.0 **STANDARDIZATION:** For 2V 1100Ah cells Battery box has been standardized to suit all make of Battery. The Battery shall be accommodated in 28+28 configuration in two-Battery box in M.S module/tray. Battery box cradle shall be as per RDSO Drg. No. SK -K 0037 Alt.3 (or latest).
- 10.0 **DRAWING:**
- 10.1 The manufacturer shall supply one set of drawing in A4/A3 size listed as below for approval while offering the cell / mono-bloc for type testing. Soft copy of part drawing with 3D view shall also be submitted.
- a) Cell/monoblock drawing with dimensions of front, top and side view
  - b) Part drawings showing different sections with dimensions of front, top and side view.
    - i) Container
    - ii) Terminal post (Positive and Negative).
    - iii) Container lid.
    - iv) Pole (+Ve & -Ve).
    - v) Plates (+Ve & -Ve groups assembly).
    - vi) Separator.
    - vii) Inter cell/unit and end cell cable & connector.

Prepared by SSE/Elect.	Checked By Director/PE & Metro
------------------------	--------------------------------

viii) Safety valve

## 11.0 RELIABILITY:

11.1 RDSO approval means the approval of general design features. Notwithstanding the approval, manufacturer is wholly and completely responsible for performance, life and reliability of Battery during service.

11.2 After the prototype approval no designs change shall be undertaken by manufacturer on prototype cell/Batteries without prior approval of RDSO, failing to which the approval may be withdrawn by RDSO at any time

11.3 If considered necessary RDSO may undertake re-testing of some or all prototype tests as per this specification at any time to ensure proper effective quality control being exercised by the manufacturer at different stage of manufacturing.

11.4 RDSO may, also undertake some special tests for concerned manufacturers to validate the design changes for which all the necessary testing equipment etc. shall be arranged by the manufacturer free of cost.

11.5 Manufacture shall be responsible for reliable performance and life of cells/Batteries in the field.

## 12.0 DESIGN DOCUMENTS AND INSTRUCTIONS MANUAL:

a) One set of drawing as per clause 10.0 of the specification before offering for type tests.

b) In house test result as per annexure 'A' and 'B' shall be sent to RDSO before offering for type test. After completion of tests following documents in bound booklet should be submitted in duplicate.

c) After completion of prototype test manufacturer shall submit two copy of following documents in bound form for approval. One copy duly approved shall be returned to manufacturer.


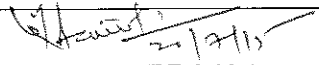
- Bill of Material
- Design details
- ISO Certificate with letter of issuing authority
- Drawings
- Prototype test result
- Quality assurance inspection plan.
- Maintenance manual.

d) Maintenance manual and QAP in soft and hard copy should be submitted in advance for approval.

e) Alternative superior designs can be considered provided necessary technical justification with benefits is furnished for scrutiny.

13.0 **IN-FRINGEMENT OF PATENT RIGHTS:** Following undertaking to be signed and submitted by vendor during registration of item:

"Indian Railways/ RDSO shall not be responsible for infringement of patent rights arising due to similarity in design, manufacturing process, use of similar components


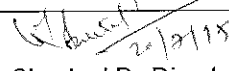
 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	---

in the design & development of this item and any other factor not mentioned herein which may cause such a dispute. The entire responsibility to settle any such dispute/matters lies with the manufacturer/supplier.

Details/design/documents given by them are not infringing any IPR and they are responsible in absolute and full measure instead of Railways for any such violation. Data, specifications and other IP as generated out of interaction with Railway shall not be unilaterally used without the consent of RDSO and right of Railways/RDSO on such IP is acceptable to them".

- 14.0 OTHER REQUIREMENTS:** The firm shall have valid ISO-9000 Certification from a reputed Certifying Agency regarding compliance to establishment of the Quality Systems for ensuring quality product by its effective implementation during various stages of manufacturing from raw materials process controls, testing, quality checks to finish product.
- 15.0 AFTER SALES SERVICE:**
- 15.1** The manufacture shall make necessary arrangements for closely monitoring the performance of cells through periodical (preferably once in three months during the warranty period) visits to the location where they have been installed for observations and interaction with the operating and maintenance personnel of the Indian Railways. Arrangements shall also be made by the successful tenderer for emergency, stand by spare parts being kept readily available to meet exigencies warranty replacement so as to keep the cell in service with least down time.
- 15.2** The successful tenderer shall respond promptly to any call given by Indian Railways for any assistance by way of attending to failures. Investigation into the cause of failure includes tests to be done and for such other items with a view to see that the equipment serves the purpose for which it is intended. Technical guidance to ensure proper operation and maintenance of the equipment shall be constantly rendered.

\*\*\*\*\*

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--

## ANNEXURE 'A'

## SCHEDULE OF DESIGN PARTICULARS

The following particulars are required to be supplied by the manufacturer with the quotation:

SN	Description	Particulars to be filled in
1.	Make	
2.	Type of unit	
3.	Manufacturer's nomenclature	
4.	Overall dimensions of unit (length x width x height)	
5.	Mass per unit with acid	
6.	Cell container material	
7.	Type of positive plates	
8.	Type of negative plates	
9.	Separators	
10.	Quantity of electrolyte per cell (litres)	
11.	Sp.Gr.of electrolyte for initial filling at 27 degree centigrade	
12.	Material of terminal and inter-cell Connectors	
13.	Normal charging rate (Amps)	
14.	Internal resistance (Ohms)	

## ANNEXURE 'B'

## SCHEDULE OF PERFORMANCE

SN	Description	Particulars to be filled in
1	Following particulars reg. the type tests shall be supplied by the manufacturer along with the certificate against any quotation or tender	
2	RDSO type approval certificate No. with date and validity	
3	Amper-hour capacity (Actual)	
4	C10 .....Ah	
5	C5 .....Ah	
6	C3 .....Ah	
7	Amper-hour efficiency	
8	Watt hour efficiency	
9	Storage and Retention of charge	
10	Life Units	
11	Recharge capability	
12	Loss of cell weight .....gm/Ah/cell	
13	Charge and discharge curves with voltage versus time for cell for discharge at 10 Hours rate and charge at normal rate.	
14	Safety valve open/closed .....PSI	
15	Equilibrium float current	
16	Internal resistance	
17	Conductance	
18	Capacity (C10) at 0 deg.C. %	
19	Recombination efficiency	

Prepared by SSE/Elect.

Checked By Director/PE & Metro

## ANNEXURE 'C'

**SAMPLE FOR TYPE TESTING**

SN	TEST	SAMPLE NUMBER									
		1	2	3	4	5	6	7	8	9	10
1.	Checking of dimensions, mass, markings and workmanship	x	x	x	x	x	x	x	x	x	x
2.	Capacity at 10 hrs. rate	x	x	x	x	x	x	x	x		
3.	Material and component specification verification test										x
4.	Conductance	x	x	x	x	x	x	x	x		
5.	Air pressure									x	x
6.	Life			x	x						
7.	Watt hour and ampere hour efficiency					x	x				
8.	Capacity at 5 hr. rate					x	x				
9.	Capacity at 3 hr. rate					x	x				
10.	Storage and Retention of charge					x	x				
11.	Gas recombination efficiency	x	x								
12.	Capacity (C10) at 0 deg. C	x	x								
13.	Equilibrium float current	x	x								
14.	Loss of cell weight	x	x								
15.	Valve open/closed							x	x		
16.	Recharge capability							x	x		
17.	Vibration							x			
18.	Internal resistance									x	x
19.	Permissible discharge current									x	x

## ANNEXURE 'D'

**SAMPLING PROCEDURE FOR ACCEPTANCE TESTS**

1. **LOT:** In the consignment, all the Batteries of the same rating manufactured from the same material under similar conditions of production shall be grouped together to constitute a lot. These Batteries in the sample shall be drawn from the lot at random. For the purpose of random selection, reference may be made to IS: 4905-1968 or latest.
2. **SAMPLE SIZE AND CRITERIA FOR CONFORMITY**
  - 2.1 The Acceptance tests shall be conducted on minimum two samples up to a maximum of 1 percent of each type in a lot, the samples being drawn at random by the purchasing or inspecting authority as specified in Appendix "G" of IS: 6848 with latest version or amendment.
  - 2.2 If any of the samples Batteries 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 re-test, the lot may be rejected.

XXXXX

 Prepared by SSE/Elect.	 Checked By Director/PE & Metro
---	--