




Bharat Heavy Electricals Limited BhopalCentre for Electric TransportationSpecification of 500 AH 24V VRLA starter battery for KMMC/ AC- SPICSpecification no. - CET/6.7/SP0038/T07 Rev. 00 Dt. 29.05.2026

REV	DATE	PREPARED BY	CHECKED BY	APPROVED BY
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Specification no. - CET/6.7/SP0038/T07 Rev. 00 Dt. 27.05.2026

1. Introduction:

This specification has been prepared for supply of 500Ah 24V VRLA starter Battery for Kavach Mobile Maintenance Car / 8-Wheeler Air-Conditioned Self-Propelled Inspection Car (8W AC-SPIC) for operation on broad gauge (1676 mm) electrified routes of Indian Railways. The 8- Wheeler Self Propelled Inspection Car (SPIC) is a self-propelled vehicle and is used for periodic inspection & patrolling. The 500Ah 24V VRLA starter Battery shall be as per cl. 1.1.3.1 of ICF spec. ICF/MD/SPEC/349 ISSUE STATUS 00 REV 01 along with battery box to ICF drg. No. ICF/SK3-7-2-050 (latest).

2. Document submission:

Supplier to furnish following documents along with offer:

- (i) The bidder shall give clause by clause compliance of BHEL specification, cl. 1.1.3.1 of ICF spec. ICF/MD/SPEC/349 ISSUE STATUS 00 REV 01 and RDSO/PE/SPEC/AC/0009- 2014 REV. 02 (where ever voltage and AH rating are mentioned in the spec., it should be considered as 24 V and 500 AH respectively).
- (ii) ICF/RDSO Approval.
- (iii) GA drawing/schematic drawing.
- (iv) Test Schedule/QAP.
- (v) 2-year maintenance Spare parts list along with price. Spares price list will not be considered for bid evaluation.

3. Scope of supply :

Supply of VRLA Starter Battery (500Ah 24V) as per clause no. 1.1.3.1 of RDSO Spec. No. ICF/MD/SPEC-349 for use in KMMC/AC SPIC. Necessary support shall be provided during installation and commissioning at Indian railway PU.

3.1. The 500Ah 24V VRLA Starter battery shall be comprising of 12 Nos. of 2V modules along with inter cell connectors confirming to RDSO Specification No. RDSO/PE/SPEC/AC/0009- 2014 (Rev.2).

3.2. The battery shall be supplied with mounting frame arrangement suitable for accommodating 500Ah 24V VRLA Battery. Overall arrangement of frame shall be as per ICF Drawing No. ICF/SK3-7-2-050 (latest). Drawing copy is attached with tender document.

3.3. A front cover shall be made of fire retardant, 4 mm thick, scratch free polycarbonate sheet approved by Indian Railway PU,s shall be provided with suitable SS mounting brackets & SS hardware to prevent contact of foreign materials.

4. Installation & Commissioning:

Supplier has to arrange necessary support during installation and commissioning at ICF Chennai on call from BHEL Bhopal.

5. Warranty:

Warranty will be 42 months after the date of delivery at BHEL Bhopal or 30 months from Installation and commissioning at IRPU/shed and completion of field trial at site/shed, whichever is later.

Note: Date of commissioning for warranty purpose shall be considered as the date of signing of commissioning report by the User Railway representative.

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ENGINE AND ELECTRICS TRACTION EQUIPMENT SPECIFICATION FOR 8-WHEELER AIR CONDITIONED SELF PROPELLED INSPECTION CAR (ACSPIC) WITH UNDER SLUNG ELECTRIC TRANSMISSION					ICF/MD/SPEC-349 AMENDMENT NO.1 CS-01 ISSUE STATUS:00 REV : 01 DATE:09-07-2020
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**GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS**



**ENGINE AND ELECTRICS TRACTION EQUIPMENT SPECIFICATION FOR
8-WHEELER AIR CONDITIONED SELF PROPELLED INSPECTION CAR
(ACSPIC) WITH UNDER SLUNG ELECTRIC TRANSMISSION
(JULY 2020)**

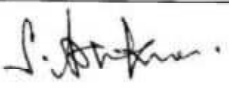



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Chapter - I**GENERAL CONDITIONS****1.1 Scope**

1.1.1 This specification covers the design, manufacture, supply, installation and testing & commissioning of Engine and Electrics required for 8-Wheeler air-conditioned self-propelled Inspection car (ACSPIC) for operation on broad gauge (1676mm) electrified (25 kV a.c.) routes of Indian Railways. The 8-Wheeler Self Propelled Inspection car (SPIC) is a self-propelled 2-axle vehicle and is used for periodical inspection, patrolling. The 8-Wheeler Inspection car (SPIC) uses the power generated by the Diesel Alternator set provided in the SPIC car for propulsion and not the power from live OHE.

1.1.2 In case of difference between the specification and / or exhibited drawings, the tenderer shall get an immediate clarification from ICF, which shall be final authority for clarification.

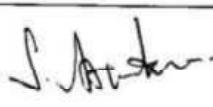
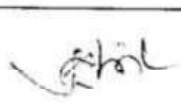
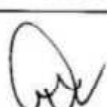

1.1.3 Scope Of Supply:

Sl. No.	Description of Equipment	Qty/ACSPIC	Rate Rs.
1	Under-slung naturally aspirated, turbo-charged and after cooled Diesel Engine of continuous rating of 340 HP (min) of proven design of Cummins make NTA-855R or similar other reputed make, suitable for 8-Wheeler SPIC with starter motor, starter protection unit and all standard accessories including base frame and AVMs.	1 set	
2	Diesel engine cooling System viz radiators and radiator fan, Hydrostatic/Electrical Drive and control arrangement Complete	1 set	
3	Engine driven Air compressor with suitable mounting and coupling arrangement and other accessories	1 set	
4	Electronics Governing system	1 No	

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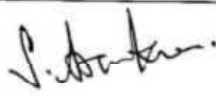
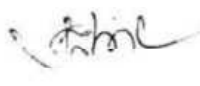


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5	Actuator	1 No	
6	Gauges, Instruments and Safety devices	1 set	
7	Engine starter battery charging system (as part of Diesel engine) .	1 set.	
8	Screened cable for governor-engine connections, meters etc.	As required	
9	Three phase variable speed, self-ventilated, separately excited and brushless and under-slung Traction Alternator	1 set	
10	Full wave three phase silicon diode bridge Power rectifier designed for natural cooling.	1 set	
11	Traction motor with pinion, gear, gear case, nose suspension block, motor suspension unit (with taper roller bearing arrangement) leather bellows for air intake and all hardware's for mounting the traction motor on to the bogie.	2 sets	
12	Control Equipment and Instruments as per the specification which includes Prewired Driver Desk, Control Cubicle, Motor Switch Group Cubicle and Resistor Panel.	1 set	
13	Installation, testing and commissioning for all equipment to be supplied.	1 set	
14	Speed indicator and recording equipment as per RDSO Spec. No. MP-0.3700-07 (latest), suitable for speed range of 0-160 kmph. One cab of SPIC will have one recorder cum indicator and the other cab will have one speed indicator only.	1 set	
15	Recommended list of Consumable for 2 years for Engine.	Rate to be quoted separately	
16	Recommended list of 2 Years maintenance Spares for: i) Flexible coupling/Engine connection (complete) ii) Traction Alternator iii) Power Rectifier	Rate to be quoted separately	

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	iv) Air compressor (complete) v) Traction Motor		
17	Type testing and Routine testing of Diesel Engine and Electrics.	1 set	
18	External 24V DC Battery Charger confirming to Specification No. ICF/ELEC/848.	1 no.	
19	Starter Battery as per Cl. 1.1.3.1 and along with mounting frame to ICF Drg.No. ICF/SK3 7-2-050 (latest).	1 Set	
20	Twin stud terminal board to Col-II of ICF Drg.No. DETC/US-7-2-017. (Latest)	1 No	
21	VRLA Control battery as per Cl. 1.1.3.2 and along with Battery box to ICF Drg.no. DETC/US 7-2-015 (Latest).	1 Set	
22	EPDM cable sealing system as per Cl. 1.1.3.3	1 set	
23	LED based flasher light and control unit system, to RDSO specification no: ELRS/SPEC/LFL/0017 (latest) suitable for use in supply system voltage of type 'E'. The lamp unit and the flasher unit shall be dimensionally interchangeable respectively to the units to Drg.No. ICF/SK 7-5-047 alt.'b' and ICF/SK 7-5-048 alt.'a' Note: RDSO approved sources only accepted.	2 Sets	
24	Distribution and pump control panel to ICF Drg.No. SPICAC 7-2-006 (Latest)	1 no.	
25	RMPU, Control Panel and Microprocessor control unit as per Cl.1.1.3.4	1 Set	
26	40KVA DA set to ICF Specification No. ICF/ELEC/163 Eligibility Criteria: ICF/RDSO approved sources for 75 kVA / 500KVA DA set (or) any other DA set manufacturers who have supplied DA sets in the range of above mentioned capacity for Rolling Stock application other than Indian Railway, shall only be considered.	1 Set	
27	External supply sockets suitable for underframe	1 set	

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	mounting (2 nos) for RMPU Precooling Purpose		
28	Underframe cable routing and it's duct/tray arrangement.	1 set	
29	Adopter plate for Marker cum Tail light mounting to ICF Drg.No. DMU/DPC3/SS-9-0-309 Col-I.	4 Nos.	
30	All power cables, control cables, data communication and special cables like optic fiber cable, with necessary crimping sockets, cable markers, heat shrinkable tubes.	1 set	
31	Annual Maintenance Contract for 05 years as per Annexure-9	1 set	

Note: (i) For all the above equipments necessary mating connectors with hardware and accessories shall be in the scope of supplier.
(ii) OGA Drawings for items under the scope of supplier and General Schematics for power and control circuits shall be submitted to ICF for approval before commencement of supply.

1.1.3.1 STARTER BATTERY:


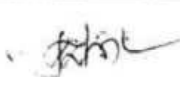


500 Ah 24V VRLA battery comprising of 12 nos. of 2V modules along with inter-cell connectors generally conforming to RDSO Spec.No. RDSO/PE/SPEC/AC/0009-2014 (Rev.2). The battery shall be suitable for 1600 HP engine starting meeting the following duty cycle

Engine cranking profile for 1600 HP DEMU Engine: Maximum cranking current – 800A, Battery voltage shall not fall below 20Volts.

Cranking cycle consists of following sequence:

1st start : 15 seconds 'on' and 10 seconds 'off' 2nd start : 15 seconds 'on' and 10 seconds 'off' 3rd start : 15 seconds 'on' and 10 seconds 'off' 3 cranking cycles can be performed with time interval of 2 minutes between the cycles. Next set of cranking cycle can be followed after time interval of 10minutes.

The battery shall be supplied along with frame arrangement suitable for accommodating 500 Ah 24V VRLA battery. The overall arrangement of the frame shall be as per Drg. No.ICF /SK3 -7-2-050. However, any modification

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required on this arrangement to accommodate 500 Ah VRLA battery can also be carried out in consultation and approval of ICF.

Note: a. The OGA drawings and BOM shall be got approved before commencement of prototype unit.

b. One prototype sample shall be submitted for approval, before commencement of bulk supply.

c. Previous suppliers of this item to ICF shall only be considered for bulk order

1.1.3.2 CONTROL BATTERY:

Valve regulated lead acid (VRLA) control batteries 110V, 120 Ah capacity suitable for system comprising of 18 modules each consisting of 3 cells with intermodule connector complete including nuts and bolts conforming to RDSO Specn. NO.RDSO/PE/SPEC/AC/0009-2008 (Rev-1) with amendment no.1. or latest

NOTE: RDSO Approved sources only shall be considered.

1.1.3.3 EPDM CABLE SEALING SYSTEM:

EPDM cable sealing generally conforming to RDSO Spec. RDSO/2008/EL/SPEC/0067 (latest) shall be provided for all cable and pneumatic pipe entries from underframe area to on board, the cut out details of coach floor shall be followed as per ICF Drg. during detail design stage. The mesh arrangement shall be provided on coach floor for power rectifier hot air out.


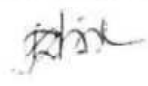


Note: RDSO approved sources shall only be considered.

1.1.3.4 RMPU, CONTROL PANEL AND MICROPROCESSOR CONTROL UNIT:

RMPU, Control Panel and Microprocessor control unit for use in Self-propelled Inspection Car (SPIC) and shall meet the following requirements.

i) LHB Type ROOF MOUNTED AC PACKAGE UNIT TYPE-II suitable for R-407C refrigerant shall be as per RDSO specification No. RDSO/PE/SPEC/AC/0061-2005 REV-1 and Micro-processor controller unit shall be as per RDSO Specification No.RDSO/PE/ SPEC/AC/0139-2009 REV.1, Type-I.

ii) AC Control Panel for RMPU shall have switch gears like contactors, MPCB, MCB, Relays, OVRs, Indication lamp etc., as per RCF Drg: No. SKED

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625, RDSO/PE/SK/AC/0190-2015(REV.0), RDSO/PE/SK/AC/0186-2015 (REV.0) & RDSO/PE/ SK/AC/0158-2011 (REV.0), to the above specification. The cage clamp type terminal connectors required for input and output (power and control cables of RMPU) shall be provided in the control panel (Acceptable makes of terminal blocks is WAGO, PHOENIX & WEIDMULLER).

iii) The overall dimension of the control panel shall not exceed 550 mm x 800mm x 200mm (WxHxD).

iv) The micro-processor controller and switch panel as per drg.no.RDSO/PE/SK/AC/0125 Rev.1 2009 shall be integrated in to AC control panel.

v) The control panel shall be supplied along with power and control cables for connecting with RMPU as per RCF specn-EDTS-252, Rev-I, Annexure-B harness nos-31, 31A31B, 31C, 31D & 31E to a length of 20mtrs for operation of RMPU.

vi) The overall dimensional drawing and BOM for the control panel shall be submitted for approval before offering for prototype inspection.

NOTE: 1) RDSO approved sources for LHB RMPU only be considered.


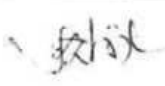


2) Earthing lug arrangement on RMPU shall be as per Drg.No.ICF/SK3-7-6-035.

3) PACKING INSTRUCTION: Roof Mounted AC Package Unit packed with corrugated paper with water proof jute fabric and supplied and stacked in pallets at ICF. The pallets should be painted and have firm's logo for identification. The firm will collect empty pallets only after AC package unit is loaded in the coach.

1.2 CLIMATIC CONDITIONS

1.2.1 The power pack & electrics of the ACSPIC shall be in continuous operation under the following atmospheric and climatic conditions: -

1	Atmospheric temperature	Metallic surface temperature under Sun: 75° C max. and in shade: 55 °C max. Minimum temperature: - 10°C (Also snow fall in certain areas during winter season).
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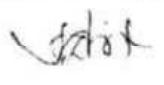


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2	Humidity	100% saturation during rainy season.
3	Reference site conditions	vi) Ambient Temp. : 50° C vii) Humidity: 100% viii) Altitude: 1000 m above mean sea level.
4	Rain fall	(i) Ranging from 1750 mm to 6250 mm. (ii) Number of rainy days/annum 120
5	Atmosphere during hot weather	Extremely dusty and desert terrain in certain areas. The dust concentration in air may reach as high as of 1.6 mg/m ³ . In many iron ore and coalmine areas, the dust concentration is very high affecting the filter and air ventilation system.
6	Coastal area	ACSPIC car and its equipments shall be designed to work in coastal areas in humid and salt laden atmosphere with maximum pH value of 8.5, sulphate of 7mg per liter, max. concentration of chlorine 6 mg per liter and maximum conductivity of 130 micro tiliza/cm.
7	Vibration	The equipment, sub-system and their mounting arrangement shall be designed to withstand satisfactorily the vibration and shocks encountered in service as specified in clause 1.2.2. High level of 50 g vibration and shocks. Accelerations over 500 m/s ² have been recorded at axle box levels for long periods during run. Vibrations during wheel slips are of even higher magnitude.
8	Wind speed	High wind speed in certain areas, with wind pressure reaching 200 kg/m ²

1.2.2 The equipments and their arrangement shall withstand satisfactorily, the vibration and shocks normally encountered in service which are as below:-

- (a) Maximum Vertical Acceleration 3.0g
(b) Maximum Longitudinal Acceleration 5.0g
I Maximum Train Acceleration 2.0g
[g: Acceleration due to Gravity]

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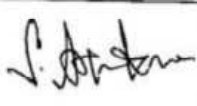



- 1.2.3 The ACSPIC car shall be able to negotiate water logged tracks at 10 kmph, with water level of 102 mm above the rail top, for which the Equipment shall be suitably designed.
- 1.2.4 The ACSPIC car and its principal assemblies shall be designed and manufactured to give satisfactory performance in the tropical climate, having very dry & dusty regions in arid zones of the country, to humid coastal areas and extreme cold climate of the northern region..

1.3 Examination of the Tender Offer:

- 1.3.1 The tenderer is required to furnish clause by clause comments to this specification, either confirming acceptance of the clause or indicating deviation there from.
- 1.3.2 The tenderer shall submit detailed scope of supply duly covering all technical requirements covered in this specification with quantity and its price break-up in the offer.
- 1.3.3 A comprehensive specification of the ACSPIC car as offered shall be submitted separately.
- 1.3.4 In the event a tenderer is unable to comply, either partially or fully, to any of the stipulations made in this specification, it must be brought to the notice of purchaser with full particulars of the deviations, technical details, cost implications and past service performance, etc.
- 1.3.5 Rates quoted for recommended consumable spares, maintenance spares at sl. no.15 & 16 respectively of scope of supply shall not be considered for evaluation of tender.

1.4 Design Development:

- 1.4.1 The successful tenderer (hereafter called as contractor) shall develop the design based on the details given in this specification and sound engineering practices. The entire design & technical data along with calculations shall be submitted to ICF for approval before commencing construction of ACSPIC car or placing orders on sub-contractors.
- 1.4.2 The design shall be based on S.I. Units.
- 1.4.3 From the information given in this specification and instructions of ICF, the contractor shall prepare a full set of engineering drawings and submit the same to ICF for approval.

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ENGINE AND ELECTRICS TRACTION EQUIPMENT SPECIFICATION FOR 8-WHEELER AIR CONDITIONED SELF PROPELLED INSPECTION CAR (ACSPIC) WITH UNDER SLUNG ELECTRIC TRANSMISSION	ICF/MD/SPEC-349 ISSUE STATUS:00 Rev: 01 Date:09-07-2020 Page 11 of 71

1.4.4 When submitting drawings of a particular detail, other details depending on it shall be shown in juxtaposition.

1.4.5 Material specifications, manufacturing tolerances and other details, which are necessary for manufacture for each component shall be indicated on the drawings.

1.5 Approval of Drawings:

1.5.1 "Approval" to the drawing means the approval to the general adoptability of the design features. ICF shall not be responsible for the correctness of dimensions on the drawings, materials used, strength or performance of the components. The contractor shall be wholly and completely responsible for all these variables. The contractor, when submitting proposals or designs for approval of the ICF, shall draw attention to any deviation or departure from the specification involved in his proposals or drawings.

1.5.2 Drawing for approval shall be submitted in standard size (s) as per IS: 696 along with main calculation details in triplicate. Any other drawings of which manufacturer desires to obtain approval of ICF shall also be submitted to ICF.





1.6 Prints:

1.6.1 Three sets all component and electrical drawings in hard copies and soft copy in Auto-Cad / 3D format shall be submitted to ICF for approval.

1.6.2 Each set of tracings shall form a complete set of working drawings, the first sheet being the index and the following sheets being arranged properly to show the various assemblies, sub-assemblies and components of complete works in the following sequence:-

(a) Diagram sheets show the overall dimensions of the equipment, weights and the relation of overall dimensions to the space in the ACSPIC car.

(b) Lists of all parts grouped into major assembly with details of numbers per set, weight, specification material and drawing reference against each item.

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- I General arrangement drawings of complete equipment sets.
Diagram of lubrication points indicating type of lubricant. Sub-assembly arrangement, drawing in proper and logical sequence.
- (d) Detailed drawings:- On detailed drawing sheets, each part shall be identified by an alphabetic letter and the list of all parts forming the sub-assembly shall be tabulated just above the title block on the same sheet giving details against each alphabetic letter.

1.7 Contractor's responsibility:

- 1.7.1 The contractor shall be entirely responsible for the execution of the contract strictly in accordance with the terms of this specification and the conditions of contract, not withstanding any approval which ICF or the Inspecting officer may have given:


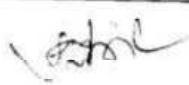


- (a) Of the detailed drawing prepared by the contractor.
(b) Of the sub-contractors for materials.
(c) Of other parts of the work involved by the contractor.
(d) Of the tests ACSPIC carried out either by the contractor or by the ICF or the Inspecting Officer.

1.8 Warrantee:

The Contractor (s) shall, at his (their) expense, replace any part of the equipment failing or proving unsatisfactory in service and attributed to defective/faulty design, defective material or bad workmanship, within a period of 24 months from the date of its commissioning at ICF or 36 months from the date of supply of all equipment as a set duly inspected whichever is earlier. The period of warranty shall stand extended by the duration for which the device remains inoperative under exercise of this clause. Further, should any design modification be made in the equipment as a result of defect/fault/shortcoming in the original design, the period of 24 months would commence from the date the modified part is commissioned into service.

1.9 Materials:

- 1.9.1 Materials used in the construction of the ACSPIC car shall comply with the relevant IRS specifications or Indian Standard Specifications.

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Where IRS or ISS do not exist for specific components, the contractor shall submit proposed material specification for approval of ICF.

1.10 Commissioning:

1.10.1 Pre-commissioning Tests at ICF Chennai

Supplier shall list the tests that are to be carried out on the supplied equipment after it has been mounted on the AC SPIC at ICF, Chennai or maintenance shed/workshop of IR or at any other manufacturer's premises. The commissioning protocol, instrumentation and tolerance shall be furnished.

The supplier shall be responsible for commissioning on prototypes and all series production of AC SPIC and also train staff of ICF/maintenance shed/workshop/any other manufacturer's works where the electrics supplied as per this specification shall be equipped in AC SPIC coaches in carrying out the tests. ICF or maintenance shed/workshop of IR or any other manufacturer's works shall provide qualified staff for carrying out above tests.

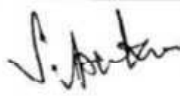
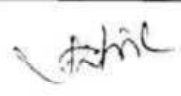


1.10.2 Commissioning of AC SPIC in user Railway

Each car shall be commissioned in user Railways by the supplier staff before putting into commercial service. The supplier will commission two prototype ACSPIC and all series production of coaches. The supplier shall furnish Commissioning protocol for the supplied equipment and the system which shall also include the following:-

- (i) Confirming satisfactory functioning of the all system.
- (ii) Test run in for about 1500 km over 3 days to confirm specified operating parameters such as acceleration, deceleration.
- (iii) Rectification replacement of any malfunctioning equipment.
- (iv) Check of all safety related items.

1.11 Service Engineering:

- 1.11.1 The Contractor shall arrange for commissioning of the ACSPIC car immediately after their receipt at ultimate destination. He is also required carry out joint check of the receipt of components regarding short shipment or transit damages.

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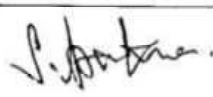
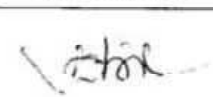
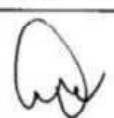

- 1.11.2 The contractor shall ensure commissioning of the ACSPIC car within 30 days from the date of intimation by the consignee.
- 1.11.3 The performance of ACSPIC Car shall be demonstrated by the contractor after its successful commissioning at the consignee's works.
- 1.11.4 The contractor shall provide and ensure servicing facilities in India throughout the warranty period. After the warranty period is over, he shall, on call, give service support for troubleshooting and for obtaining spare parts.
- 1.11.5 A well designed and informative electronic portal for lodging of complains and action taken by supplier shall made operative before dispatch of first prototype vehicle.

1.12 Training:

- 1.12.1 The Contractor shall arrange to provide training to at least 05 personnel (maintenance and operation staff) of each division of that Zonal railway for minimum 03 days at their work's premise & at their place each. The training material shall be supplied as per Annexure-8.
- 1.12.2 The cost of training shall be included in the price of ACSPIC. The charges for travel, boarding and lodging of trainees shall be borne by the Railways.

1.13 Service Manuals and Spare Parts Catalogues:

- 1.13.1 Detailed Maintenance & Service Manuals including the manual for trouble shooting & operational requirement, spare parts catalogues for the driver and maintenance staff for the ACSPIC car shall be prepared and three copies supplied free of charge per ACSPIC to the consignee before printing the final version of the manual.
- 1.13.2 Three copies per ACSPIC cars of Spare Parts Catalogues & list of must change items with periodicity & sources of supply shall also be supplied to the consignee.
- 1.13.3 In addition, three sets of hardcopy and softcopy of the Maintenance/Service and troubleshooting manual shall be supplied to ICF.

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1.14 Spare Parts:

1.14.1 Unit exchange spare parts shall be indicated. However, final decision to buy these will rest with the purchaser.

1.14.2 The prices for these spares shall be quoted separately. The complete details such as part number and their quantity shall be clearly indicated against following items with the offer.

- i) Flexible coupling/Engine connection (complete)
- ii) Traction Alternator
- ix) Power Rectifier
- x) Air compressor (complete)
- xi) Traction Motor


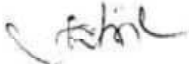
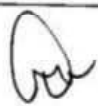

1.14.3 The prices for these spares shall be quoted separately. The prices shall not be used for tender evaluation purpose.

1.14.4 The tenderer shall be responsible to ensure subsequent availability of the spare parts for the normal life of the respective equipment.

1.15 Quality Assurance Plan

1.15.1 The contractor should possess valid ISO-9001:2000 certificate for his work's address, covering the items for which he is participating in the contract. The contractor shall formulate Quality Assurance program (QAP) detailing the methodology proposed to be followed to ensure a quality product. QAP shall cover quality assurance procedures and procedures to be followed during all stages of design, manufacture, testing and commissioning of the equipment. The Contractor shall define the role of each functional group in the Organisation for achieving the required quality of the product and submit a comprehensive document "Quality assurance plan" in accordance with RDSO guideline QM-RF-8.13 Dated 28-08-2018.

1.15.2 The Tenderer whose bid is accepted, shall be required to submit a "Quality Assurance Plan" by giving details as to how the quality of specific product is proposed to be assured. Supply of the equipment

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shall commence only after "Quality Assurance Plan" has been approved by RDSO/ICF.

The above shall apply to the main contractor as well as sub-contractors.

1.16 Reliability, Availability, Maintainability and Safety

1.16.1 The company shall design the ACSPIC to ensure Guaranteed Reliability, Guaranteed Availability and high degree of safety in order to provide a dependable service. The optimization of the system with respect to Reliability, Availability, maintainability and safety shall form an integral element of these Specification and Standards.

The plan for Reliability, Availability, Maintainability and Safety shall conform to EN 50126/IEC 61709/IEC 62278.

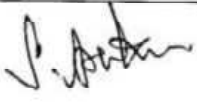
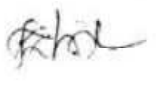


1.16.2 The company shall develop RAMS targets both for the complete system and for the major Sub-systems such as Diesel engine, main alternator, power rectifier, motor switch group, 40KVA DG set, electronics, traction motor, Transmission System, high voltage equipment, blowers and other auxiliary machines etc., such that it will provide a high level of dependability.

1.16.3 There shall be an efficient means of operation of the coach after all failures in accordance with Good Industry Practice.

1.16.4 Components critical for safety shall fall into safe operating mode in case of malfunctioning. The system safety plan shall identify and list safety critical components and this list shall be updated periodically.

1.16.5 The company shall establish and operate a detailed reliability, availability, maintainability and safety (RAMS) Assessment system in support of the design, manufacture and subsequent testing, commissioning, operation and maintenance of the coach.

1.16.6 Safety Assessment shall be carried out and shall include the following principles:





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- (i) Degraded modes and emergency operations shall be considered as well as normal operations;
- (ii) Safety risk assessment shall utilize more than one methodology to assess risks; and
- (iii) Safety risk assessment shall include the consideration of dependent failures, in particular the traction power, braking and control systems.

1.16.7 No single-point of failure shall cause complete failure of the traction system, auxiliary supply system or inability to control the brakes on coach.

1.16.8 Where the system design of the equipment incorporates component redundancy as the method of reducing the consequences of a single point failure, such redundancy shall not allow hidden faults to remain undetected.

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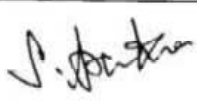
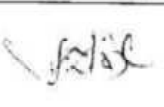
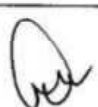

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Chapter –II

**DIMENSIONAL OPERATING AND OTHER REQUIREMENTS FOR ACSPIC
CAR**


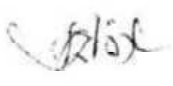


2.0 The ACSPIC Car shall dimensionally conform to the following:

1.	Track gauge	1676 mm
2.	Minimum radius of curve	175 m. It should also be capable of negotiating i) a radius of 213m in case of 1 in 8-1/2 BG turnout with 6.4m over-riding switch. ii) 175 m radius in case of 1 in 8-1/2 scissors crossing.
3.	Maximum super elevation	185 mm
4.	Maximum Super - elevation deficiency	100mm
5.	Maximum wind pressure	200 kg/m ²
6.	Maximum moving Dimensions	Maximum moving dimensions shall conform to diagram 1D of Indian Railway Schedule of Dimension (SOD) 1676 mm gauge (BG) revised 2004. Infringements, if unavoidable and fully justified, may be considered, if within the limits shown in SOD 1676 mm gauge (BG) revised 2004.
7.	Maximum permissible wheel base length of the ACSPIC car, over hang beyond bogie center, buffer height draw bar height	These shall conform to Indian railway, schedule of dimension 1676 mm gauge (BG) Revised 2004. Adequate clearance shall be allowed so that no component of the ACSPIC car shall infringe a minimum of 102 mm above rail level with wheels in fully worn conditions, full deflection of springs and effect of dynamics.
8.	Maximum Axle load	20.32 t
9.	(a) Maximum Speed when	110Km/h

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	coupled to a train (b) Max operating speed under its own power	110 km/h	
10.	Brakes	All wheels with clasp brakes.	
11.	Service Braking	Pneumatic	
12.	Performance capabilities:-	i) Pay load (excluding Power equipment)	12tonnes (Approximately)
		ii) Period of continuous running at 110 km/h on generally tangent track followed by frequent to and fro movement at walking pace for 1-1/2 h.	5-1/2h total (4h+1-1/2h)
		iii) Period of continuous running at 40 km/h up or down gradient of 1 in 60 to be followed by frequent to and fro movement up to 5 km/h for 1-1/2 h on same gradient with speed control.	5-1/2h total (4h+1-1/2h)
		iv) Performance in monsoon and squally conditions.	Un- restricted
		v) The ACSPIC Car shall be capable of running at a speed of 25 km/h on 1 in 33 up gradient	
		vi) The ACSPIC car shall be capable of starting on an up gradient of 1 in 33. Maximum operating speed of the ACSPIC car for level and 1 in 33 up gradients shall be indicated with the offer.	
		vii) The emergency braking distance (EBD) for fully loaded (20.32x4=81.28 t) ACSPIC car from maximum speed of 110km/h to zero shall not be more than 800m on flat section. The contractor shall associate during EBD trial test done by RDSO.	

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Telegram : 'RAILMANAK', Lucknow

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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

24th 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, बडौदा 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, हेडक्वार्टर, 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 मुंबई 400 614
- आर० सी० एफ०, कपूरथला, 144 602 (पंजाब)
- आई०सी०एफ०, 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,

(Signature)

(लीला धर 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,
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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

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21.07.15

ED/PS & EMU

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**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.


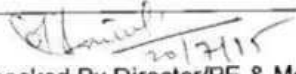
0.4 This specification covers the design development and manufacture of VRLA Batteries for 110V, TL&AC coaches as follows:-

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

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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.

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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: -

1. No deviation in the above dimensions and weight shall normally be permitted.
2. 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: -
 - i) In existing Battery boxes,
 - ii) Directly in the under frame.
3. 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.
4. 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.
5. First time, fitment report shall be obtained from ICF or RCF.

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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:

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(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.

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- 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".


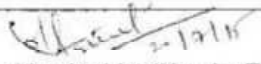
Note: The cell shall be covered by the type approval certificate from appropriate authority of RDSO. Separate type approval certificates shall cover significant variations in the design. The cell of new design shall be re prototype tested for which samples offered by the manufacturer shall be accepted.

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

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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.


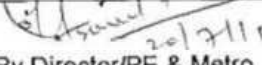
*C3 discharge test shall not vary more than $\pm 4\%$ from the value obtained during prototype testing subject to minimum 72% of C10 obtained (at 27°C) during the first C10 capacity discharge test (a). For above tests seven samples shall be picked up from any production lot at random. It shall be checked 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

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than ± 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.


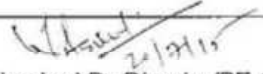
5.6.4 The capacity on the first discharge the Batteries or cells shall give within ± 3 percent of declared capacity.

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.

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- 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.

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5.10 TEST FOR RETENTION OF CHARGE AND STORAGE TEST:


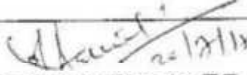
- 5.10.1 The object of this test is to determine the loss of capacity of a cell in open circuit during a specified period.
- 5.10.2 The cell shall be fully charged at the normal charging rate specified by the manufacturer and it shall then be subjected to two consecutive capacity test discharges in accordance 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.

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


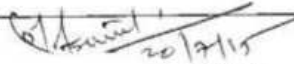
- 5.10.7 Requirement: The loss of capacity calculated as in 5.10.6 shall not be more than 3% over 180 days (six months) storage period.

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.

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- 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.

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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;

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P_o = 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 ± 0.04 grams/cc for PPCP and 1.13 ± 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).

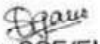
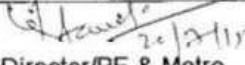
5.17.4 SEPARATORS:

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.

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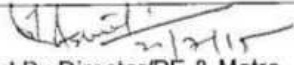
- 5.17.4.5 The total wicking height shall not be less than 25 inches in 6 hours
- 5.17.5 **SAFETY VALVE:**
- 5.17.5.1 The safety valve shall be explosion proof.
- 5.17.5.2 The vent shall release excess pressure between 2 and 7 PSI and shall reseal before the pressure drops to atmospheric pressure. Manufacturers shall declare open/closing pressure of one particular vent seal with in 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.
- Random vibration test as per clause 8 Table-1, category 1 Class B
 - Simulated long life test as per clause 9, Table-2, category 1 Class B
 - 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 carried out the test at any approved Govt. laboratory.

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- 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 channels), 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, shall have the following details marked on it:
- a) Manufacturers name or trademark embossed on container lid.

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- 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.

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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

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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.

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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	C10Ah	
5	C5Ah	
6	C3Ah	
7	Amper-hour efficiency	
8	Watt hour efficiency	
9	Storage and Retention of charge	
10	Life Units	
11	Recharge capability	
12	Loss of cell weightgm/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/closedPSI	
15	Equilibrium float current	
16	Internal resistance	
17	Conductance	
18	Capacity (C10) at 0 deg.C. %	
19	Recombination efficiency	

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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.

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