Government of India
Department of Telecommunication
Telecommunication Engineering Centre
Gate No. 5, Khurshid Lal Bhawan, Janpath, New Delhi-110001.
FA Division

File No.:**33-7/2026-FA/TEC** **Date: 17.02.2026**

Subject: Invitation for joint Sub-DCC & MF meeting of Fixed Access (FA) division to be held on 26th February 2026 in respect of revision of GR on Valve Regulated Lead Acid (VRLA) Batteries (TEC 67010:2011)-reg.

An online meeting of **joint Sub-DCC & Manufacturer's Forum (MF)** of the division is scheduled on Thursday, 26th February 2026 at 02:30 PM to discuss on the draft **revision of GR on VALVE REGULATED LEAD ACID (VRLA) BATTERIES (TEC 67010:2011).**

Online Meeting link: https://cdotmeet.cdot.in/vmeet/rooms/z0v-m4a-znr-ycy/join

2. The soft copy of the draft GR as mentioned above is enclosed for inputs/comments.

3. Members are requested to kindly provide their comments as per the attached format at Annexure -A on the various clauses of the enclosed draft GR, if any, by 24th February 2026 to adgfa-tec-dot@gov.in with copy to rafa.tec-dot@govcontractor.in; dirfa.tec@gov.in and ddgfla.tec@gov.in.

4. Members are requested to kindly make it convenient to attend the meeting.

---Sd---
Deo Pratap
AD (FA), TEC

Encl: As above

To
1. All Sub-DCC/Manufacturer Forum Members.
2. AD (IT), TEC for uploading the notice on TEC web site.

ANNEXURE-A

NAME OF .....(MEMBER/MANUFACTURER)

COMMENTS ON Valve Regulated Lead Acid (VRLA) Batteries (TEC 67010:2011)-

Clause No.	Clause Description	Comments, if any	Remarks, if any

वर्गीय आवश्यकताओं के लिए मानक

टीईसी ६७०१०:२०२६

सं:टीईसी ६७०१० : २०११ को अधिक्रमित करता है

STANDARD FOR GENERIC REQUIREMENTS

TEC 67010:2026

(Supersedes No. TEC 67010:2011)

~~**DIVISION: FIXED LINE ACCESS**~~
~~**ISSUE IV: JUNE.2011**~~

वाल्व रेगुलेटेड लेड एसिड (वीआरएलए) बैटरीस

VALVE REGULATED LEAD ACID (VRLA) BATTERIES

ISO 9001:2015

दूरसंचार अभियांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली-110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

Release 4: xxx, 2026

~~GENERIC REQUIREMENTS~~

~~No. TEC/GR/TX/BAT-001/04.JUNE.2011~~

~~(This document supersedes the previous document "Generic Requirements No. GR/BAT-01/03.MAR.2004)~~

~~TELECOMMUNICATION ENGINEERING CENTRE KHURSHIDLAL BHAWAN, JANPATH,~~

~~NEW DELHI-110001 (INDIA)~~

FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of the Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements

- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE) Policy
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document covers the generic requirements of VRLA batteries with immobilised electrolyte for use in the Indian Telecommunication Network. The batteries are used to provide uninterrupted power supply to the Telecommunication Equipment. The batteries are normally kept on float and take over the load in case the charger unit fails due to any reason. These batteries are not recommended for high discharge (UPS) application and are recommended only for switching, transmission, Solar Photo Voltaic power supplies and similar systems requiring a discharge rate of C/6 or slower.

CONTENTS

HISTORY SHEET

Name of the Generic Requirements	No. of the Generic requirements	Remarks
Valve Regulated Lead Acid (VRLA) Batteries	GR/BAT-01/03 MAR 2004	First Issue: Batteries based on new Technology.
Valve Regulated Lead Acid (VRLA) Batteries	TEC/GR/TX/ BAT - 001/04.JUNE. 2011	Second Issue: Revised including the amendments of previous GR
Valve Regulated Lead Acid (VRLA) Batteries with Amendment	TEC/GR/TX/ BAT - 001/04.JUNE. 2011	Third issue: - Requirements in respect of some of the parameters have been changed in the relevant clauses to accommodate advancements, more optional features for the purchaser and for better clarity
Valve Regulated Lead Acid (VRLA) Batteries	TEC 67010:2026	Fourth issue: - Requirements in respect of some of the parameters have been changed in the relevant clauses to accommodate advancements, more optional features for the purchaser and for better clarity

References

S. No.	*Document No.*	*Title/Document Name*
1.	QM-333	Specification for Environmental Testing of Electronic Equipments for Transmission and Switching use.
2.	IS :1554 with Amendment-1 (June 94)	Standard for Cables & Wires.
3.	IS 266	Test for Sulphuric Acid
4.	IS 1069	Test for Distil Water Purity
5.	IS 6071	Synthetic separators for lead-acid batteries
6.	IS 6848-1979	Thickness of lead coating
7.	IS 1146-1981	Acid Resistivity, Plastic Yield Test, Impurities of unpainted surface & High voltage test.
8.	IS 8320: 1982	General Requirements and Methods of Tests for Lead- acid Storage Batteries
9.	ISO 9001:201508	Quality Management Systems Requirements.
10.	ISO 14001 (Latest Issue)	Pertaining to environmental requirements.
11.	IS 1885 (Part-8)- 1986	Electrotechnical vocabulary: Part 1 Fundamental definitions
12.	ASTM D-792-1986	Test for density of plastic material
13.	ASTM D-638-1989	Tensile strength of plastic materials
14.	ASTM D-790-1986	Flexurol Modulus of plastic materials

15.	ASTM D-256-1988	Izod Impact strength of plastic materials
16.	ASTM D-1238-1988	Melt follow rate of plastic materials
17.	ASTM D-648-1988	Heat distortion of plastic materials
18.	BS 6290	External Short Circuit Test
19.	UL-94 V-0	Underwriters Laboratories Standard on Fire Retardant Materials.
20.	IEC 61000-4-2	Electrostatic Discharge (ESD) Immunity limits

CHAPTER 1

~~SECTION-1~~

1.0 Introduction

1.1 **Scope**: This document covers the generic requirements of VRLA batteries with immobilised electrolyte for use in the Indian Telecommunication Network. The batteries are used to provide uninterrupted power supply to the Telecommunication Equipment. The batteries are normally kept on float and take over the load in case the charger unit fails due to any reason. These batteries are not recommended for high discharge (UPS) application and are recommended only for switching, transmission, Solar Photo Voltaic power supplies and similar systems requiring a discharge rate of C/6 or slower.

1.2 The batteries as per this GR are used, mainly for two applications as follows:

1.2.1 **Float and Cyclic Application:** The batteries in Indian Telecom Network are used for Float and cyclic application depending upon the requirement and location. The battery may be required to provide a back-up between 1 6 to 72 hours.

Float Application: The battery is normally not allowed to discharge beyond 80% of C (rated capacity of the battery at C/10 rate of discharge). Number of discharge cycles up to 80% DOD, per year may be up to four to five in metropolitan areas and more in the semi-urban & rural areas depending the commercial mains supply conditions. `C'', wherever used in this document, stands for the capacity of the cell/mono-block/battery at C/3.33 rate of discharge. These type of batteries are charged normally at C/3.33 rate in a constant voltage charge mode. The battery may be charged at higher rate if recommended by the manufacturer.

Cyclic Application: The battery is normally not allowed to discharge beyond 60% of C (rated capacity of the battery at C/10 rate of discharge). `C', wherever used in this document, stands for the capacity of the cell/mono-block/battery at C/10 rate of discharge. These type of batteries are charged normally at C/3.33 rate in a constant voltage charge mode. The battery may be charged at higher rate if recommended by the manufacturer

1.2.1.1 Batteries used for Float applications are normally 24cell/48V batteries. These batteries are formed by connecting 24 cells or cell modules each of 2V of the rated capacity, in series subject to compliance clauses 3.1 & 5.11.For 12V systems, 12V mono-blocks of capacity up to 150AH can be used subject to the condition that no series/parallel connections of mono-blocks is permitted. The Type Approval is to be generally granted for the battery module. TAC is valid for the battery module of particular design, capacity , Make & Model only. Maximum capacity of the battery bank shall be declared by the OEM/ manufacturer while seeking Type Approval Certificate of battery module. In case of specific requirement from purchaser for rack / battery system level certificate, rack level / battery system level Type approval certificate shall be granted.

1.2.2 **SPV Application**: In Indian Telecom Network the batteries are also used as a power reserve for Telecommunication equipment. The SPV power generator, which supplies the charging power to these batteries can deliver the current which is approximately 5% of the battery bank capacity (C/20rate of charge) for 3 to 4.5 hours on any bright sunny day and is sufficient to recoup the lost battery capacity fully, during the day. The discharge rate for these batteries is between C/20 to C/120 up to 80% of its rated capacity, depending on application requirements.

1.2.2.1 The Batteries for 12V SPV equipment/systems 12V mono-blocks or six

2Vcells (connected in series) can be used. Series/parallel connections of mono-blocks to enhance the voltage or AH capacity of the battery is not permitted. The maximum capacity of mono-blocks for use in Indian Telecom Network shall be 150AH. For the equipments working on voltage higher than 12V only 2V cells are to be connected in series to achieve the desired voltage.

1.3 The manufacturer will provide the discharge tables of the battery at C/3, C/4, C/5, C/6, C/8, C/10, C/20, C/72 & C/120 rate of discharge to enable the field unit to set the charge Controller voltage low disconnect to ensure that battery is not allowed to discharge beyond 80% of its rated capacity.

~~END OF SECTION 1~~

2.0 General Requirements

2.1 Sign-writing and labelling: All the cells/mono-blocks/batteries shall be properly sign-written with reference to the Supplier's Installation and Maintenance Manuals.

2.2 Designation: The cell/mono-block shall be designated by symbols as given in clauses
2.2.1to 2.2.4 and arranged in sequence as given below:

Cell/mono-block voltage/Type of Positive Plate/AH Rating of Cell/mono-block/Type of Container.

2.2.1 Voltage of the cell/mono-block: 2V for cell and 12V for mono-block.

2.2.2 Type of +ve Plate: The positive plates shall be
designated as: Flat Pasted type : F
Tubular type : T

2.2.3 Capacity: The capacity shall be indicated by a number equal to the capacity in AH.

2.2.4 Type of Container Material: The material of container shall be designated by any one of the following letters as the case may be:

Polypropylene	: PP
Acrylonitrile Butadiene Styrene	: ABS
Styrene Acrylonitrile	: SAN

Example: 2VF400 PP – designates 2V cell having flat pasted positive plates

and a capacity of 400 AH at C/10 rate of discharge in container of Polypropylene Material.

2.3 **Marking**: The following information shall be indelibly & durably marked.

Cells: Item 4, 5 and6 shall be hot-stamped on the cell cover. Item 9 and 10may be in acid resistant sign-writing or acid resistant sticker consistent with the life of battery on the cell cover. Item 1, 2, 3, 7, 8, 11, 12, 13 and 14 shall be screen printed on the steel tray. The other advance method may be used for permanent marking on the mono-block.

Mono-Blocks: All the information may be on the mono-block itself, item No. 4, 5 and 6 in hot-stamping, item 9 and 10 in acid resistant sign-writing or acid resistant sticker consistent with the life of battery on the mono-block cover. Item 1, 2, 3, 7, 8, 11, 12, 13 and 14 shall be screen printed on mono-block it-self. The other advance method may be used for permanent marking on the mono-block.

1. GR No.
2. Manufacturer's Name and Identification
3. Model No,
4. Serial No. of the battery/cell/mono-block.
5. AH capacity of battery/mono-block/cell at C/10 rate of discharge.
6. Month and Year of manufacture.
7. TAC No.
8. Name of the USER: BSNL/MTNL
9. Cell/cell module number indicating the position of the cell/cell module in the battery string (if required).
10 Conductance of the cell/mono-block in fully charged, at 80% DOD and fully discharged condition.

11. Date on which Charge given before dispatch:
12. Next due date for Freshening Charge :
13. The necessary corrective measure to be taken before the battery is put to use.
14. Battery voltage at 80% DOD.

2.4 **Installation & Maintenance Manual**: Two copies of the Installation & Maintenance Manual in English shall be supplied along with each unit/set. The manual shall include :

- Dimensioned lay out drawing for cell, mono-block, battery & interconnecting drawings for the battery.
- Instructions for initial treatment, installation and commissioning procedures and routine maintenance during service. It shall also give the method to recoup the capacity lost during storage.
- Detailed routine checks/tests to be carried out by the user to keep himself informed about the health of the cell/mono-block/battery and the corrective steps to avoid further deterioration of the cell/mono-block/battery, detected during such routine checks/tests.
- The procedure to check the fully charged condition of the cell/mono-block/battery and the procedure to verify the health and charged condition of the cell/mono-block/battery during operation.
- The test results obtained in the factory & feed-back format.
- Discharge tables at C/3, C/4, C/5, C/6, C/8, C/10, C/20, C/72 & C/120 rate of discharge.
- The maintenance schedule (Daily/weekly/Fortnightly/ Monthly/Quarterly/Half Yearly/Yearly) and procedure should be given clearly during storage/operation of the batteries.
- Earthing Guide lines for the battery **if required.**
- Safety measures to be observed in handling of the cells/mono blocks/modules.

- Precautions at the time of installation, operation and maintenance.
- The requirement of installation & maintenance manual (in terms of the no. of hard copy/soft copy/QR Code) may be indicated by purchaser at time of order
- The cycle life will be clearly declared by the battery manufacturers.

2.4.1 Installation & Maintenance Manual shall be prepared using good quality paper with clear and crisp printing. All the drawings in clear printing shall be attached to the hand book binding. One set of flow chart and interconnecting drawings for troubleshooting shall be provided with each manual. The handbook shall be in proper binding so as to make it presentable. A copy of the Installation and Maintenance Manual may preferably be provided on a floppy disk also.

2.5 **Instruction Card**: The requirement of instruction card may be clearly indicated by the purchaser at the time of ordering. However, the purchaser may specify only other special condition/requirements for proper working. The following information shall be provided on the instruction cards to be supplied with each battery set/mono-block:

a) Designation of cell/mono-block/battery.

b) AH capacity at C/120, C/72, C/20, C/10, C/8, C/6, C/5, C/4 & C/3 rate of discharge.

c) Nominal voltage.

d) Manufacturer's instructions for

i) Charging

ii) Maintenance

iii) Any other information/instructions for better performance of the mono- block/battery, keeping the users conditions in view.

iv) Battery Low voltage disconnect to be set up for different rate of discharge

2.6 **Field Observation**: Whenever/Wherever necessary field trials will be carried

out to assess the performance of the mono-block/battery for a period of 3 months or lesser period as decided by Regional Telecommunication Engineering Centre ~~TEC~~ before clearance for bulk production.

2.7 The shelf life of the cell/mono-block/battery shall comply with the requirements of \ the clause 5.7.

~~END OF SECTION 2~~

3.0 Constructional Features

3.1 Design Practices: The internationally adopted design practices shall be followed. The partial plating of cell/mono-block is not permitted. Paralleling of cells externally for enhancement of capacity up to 1500AH is not permitted. For higher capacity, the number of such paralleling shall be restricted to 4 only, subject to the compliance of the clause. 5.11 and minimum capacity of the basic cell is not less than 1000AH. Basic cell for this purpose also need to be type approved. In case of mono-blocks 12V mono-blocks of AH capacity up to 150 AH are permissible with the condition that no parallel/series connections of mono-blocks will be permitted to enhance the AH capacity or voltage. For test procedure refer clause 7.6.1.1 of the GR.

3.1.1 Stacking (Mounting) Arrangement: The cells shall be so designed as to be suitable of horizontal stacking while mono-blocks may be stacked, horizontally or vertically as per the manufacturer"s design. The number of stacks shall be as per order to ensure space & floor loading requirements. However, the change in the number of stacks as per order shall not be treated as a deviation from Type Approval Certificate (TAC). The stacking arrangement shall be such that end terminals of the battery shall be top two adjacent cells/modules on the same side of stack to minimise voltage drop from power plant. For test procedure refer clause 7.6.1.2 of the GR. The adequate bulging clearance shall be given during installation by the manufacture. Maximum capacity of battery bank shall be mentioned while seeking type approval for battery module.

Rack Assembly Arrangement (Optional): "The rack assembly arrangement may be up to 600 AH capacity where individual cells are arranged in row &

columns as a rack in battery bank"

3.2 Containers:

3.2.1 The container, made of suitable acid resistant plastic material shall be capable to meet all the requirements of VRLA batteries and be consistent with the life of battery. It shall also have chemical and electro-chemical compatibility. The container shall be subjected to safety standard are met.

3.2.2 The container shall be Fire Retardant and shall comply with provisions of UL-94V-0 of Underwriters Laboratories and have an Oxygen Index atleast 28%.

3.2.3 The container shall be symmetrical in shape & stand level on the plane level surface.

3.2.4 The internal area of the container shall have sufficient provision for growth of the +ve plate

3.2.5 The porosity of the container be such as not to allow any of the gases to escape except from the regulation valve.

~~3.2.6~~ The tensile strength of the material of the container be such as to handle the internal

3.2.6 pressure of the cell/mono-block in the worst working condition. Cell/mono-block shall not show any deformity or bulge on the sides under all working conditions. However, use of steel casing of proper gauge for the purpose is permitted.

3.2.7 The container shall be capable of withstanding the rigours of transport, storage, handling& internal cell pressure in the worst working condition. The container shall be enclosed in a steel tray. For test procedure refer clause

7.6.1.3.1 &7.6.4.2 of the GR. There is no tray needed in case of „Rack Assembly Arrangement (optional).

3.3 **Cell/mono-block Covers** : The cell/mono-block covers shall be made of suitable plastic material compatible with the container material & permanently sealed with the container. It shall be capable to withstand internal pressure without bulging or cracking. It shall also be fire retardant and shall comply with the provisions of clause

3.2.2 Fixing of Pressure Regulation Valve & terminal posts in the cover shall be such that the seepage of electrolyte, gas escape and entry of electro-static spark are prevented. For test procedure refer clause 7.6.1.3.1 &7.6.4.2 of the GR

3.4 **Separators :** The separators used shall be of glass mat having high acid absorption capability, resistant to sulphuric acid and good insulating properties. The design of separators shall ensure that there is no misalignment during normal operation and handling. Binders if used shall be so designed as to meet the handling requirements as per relevant clauses of QM-333 issued by QA wing of BSNL. For test procedure refer clause 7.6.1.3.2 of the GR.

3.5 **Pressure Regulation Valve:** Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The Valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure of C/5 rate of charge and C/3 rate of discharge or higher, as specified by the manufacturer for the purpose but it shall not be less than 3 psi in any condition of operation i.e. charging/discharging. In case the mono-blocks design has used a common pressure regulating valve, it shall also comply the requirement of clause 6.2 & 6.3 pertaining to Oxygen recombination & cell/mono-block

pressure in addition to the above. For test procedure refer clause 7.6.1.3.3 of the GR.

3.6 **Terminal Posts**: The terminals both +ve & -ve shall be capable of proper termination and shall ensure its consistency with the life of the battery. The surface of the terminal post extending above the cell/mono-block cover including bolt hole shall be coated with an acid resistant & corrosion retarding material. Terminal posts or any other metal part which is in contact with the electrolyte shall be made of the same alloy as that of the plates or of a proven material that does not have any harmful effect on cell/mono-block performance.

Both Positive and negative posts shall be clearly and unambiguously identifiable. The terminal posts & its sealing shall be capable to with stand the heat generated in cell/mono-block during external short circuit condition. For test procedure refer clause 7.6.1.3.4 of the GR.

3.6.1 The terminals shall be clearly and distinctively marked to ensure the correct termination of the cell/cell module/mono-block.

3.7 **Connectors**: Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connectors shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge. The thickness of the lead coating of connectors shall not be less than 0.025 mm when measured in accordance with Appendix F of IS:6848-1979. The area of cross-section of the connectors shall be sufficient to meet the requirement of the rate of discharge as per tender requirement & shall be rated at 2 amp/mm square (minimum). For test purpose it shall be C/3 rate of discharge. No flexible cable is permitted for series parallel connections. All the

basic cells shall be supplied to meet the requirement for C/3.33 rate of charging.

3.8 **Nuts, Bolts & Washers**: Nuts, bolts& washers for connecting the cells shall be made of copper, brass or stainless steel. Copper or brass nuts, bolts & washers shall be effectively lead coated to prevent corrosion. Stainless steel nuts, bolts &washers can be used without lead coating. For test procedure refer clause 7.6.1.3.6 of the GR.

3.9 **Flame Arrestors**: Each cell shall be equipped with a Flame Arrestor to defuse the Hydrogen gas escaped during charge and discharge. In case of mono-Block, using a single pressure regulating valve, the flame arrestor complying the requirements can be provided at mono-block level.

3.9.1 The material of the flame arrestor shall not affect the performance of the cell/mono- block.

~~END OF SECTION 3~~

4.0 Performance Requirements

4.1 Scope: **Cell/mono-block**./batteries shall be capable to provide the satisfactory service under the following environmental & working requirements.

4.2 Quality Requirements:

4.2.1 VRLA Batteries shall be manufactured in accordance with the International Quality Standard ISO ~~9001-2008~~ 9001:2015 for which the manufacturer shall be duly accredited.

4.2.2 Quality of material &Workmanship: All the material &workmanship shall be of professional grade and highest quality.

4.2.3 Quality Assurance Tests: Mono-blocks/Batteries supplied against specific order after Type Approval shall be inspected and tested to ensure that the requirements of this document have been met. ~~These tests shall be carried out by the QA wing of BSNL.~~ Valid BIS certificate is required for the basic cell and its model to use in battery module for getting TAC for initial module only. In case of any change in design of basic cell and / or renewal / reissue of BIS certificate, fresh valid BIS certificate is required to be submitted by the OEM / Manufacturer while getting TAC. Cell manufacturer shall mention all the technical data sheets of the basic cell along with the life cycle for getting TAC for initial module only. In case of any change in design of basic cell, fresh such technical data sheets shall be furnished by OEM / Manufacturer while getting TAC. TAC for higher capacity can be obtained for a particular capacity by performing the incremental tests as per applicable clauses of this document.

4.2.4 Disposal of unserviceable Batteries

4.2.4.1 The unserviceable batteries shall be disposed in accordance with Gazette Notification issued by Ministry of Environment &Forests "Extraordinary Part-II-Section-3-Sub-section (ii) No. 311 issued at New Delhi May 16, 2001"

4.2.4.2 The batteries shall be sold, for recycling, only to those units registered with the Ministry of Environment & Forests as recyclers processing environmentally sound management facilities for reprocessing the same.

4.2.4.3 The list of approved recyclers of used/old batteries is available in the Ministry of Environment & Forests website (URL.www.envfor.nic.in). This site is updated regularly by the ministry.

4.2.4.4 The battery manufacturer shall also comply the environmental requirements in accordance with ISO 14001(Latest issue) for which he shall be duly accredited. The manufacturer shall take necessary action for safe disposal of unserviceable batteries in accordance with the latest regulatory guidelines / Act.

4.3 Operational Requirements:

4.3.1 Ambient Conditions : All the Cells, mono-blocks & batteries shall be designed for continuous full load operation under all the conditions specified in QM-333 category. B_2 and shall be capable to work satisfactorily at an altitude specified in clause 14.4 of QM-333& saline atmosphere of coastal area in compliance of clause 11 of QM-333 respectively. It shall be capable to withstand the rigours of transportation in compliance of clause12 & 13 of QM-333.

4.3.2 Cooling Arrangements: Only natural air convection will be employed. Cells/mono-blocks/batteries shall be capable of working without fans/exhaust

fans.

4.3.3 **Fire Retardant**: The material used in composition of the cell/mono-block/battery shall be Fire Retardant and shall have a minimum Oxygen Index of 28% & shall comply UL-94V-0 for this purpose.

4.3.4 **Electro-static Discharge**: The cell/mono-block shall not explode or burn when an electro-static discharge of 15KV is applied to any of its part exposed to contact. ~~For test procedure refer clause 7.6.2.4.3 of the GR.~~ It shall be tested in accordance with IEC-61000-4-2

4.4 **Battery Reliability:** When working as a battery, failure of one or two cells shall not cause the failure of the battery and shall be able to provide uninterrupted rated power to the load. In case of mono-block failure of one cell in the mono-block shall not cause the failure of the mono-block and shall be able to provide uninterrupted rated power to the load. For test procedure refer clause 7.6.2.4.4 of the GR.

Electrostatic discharge (ESD) immunity limits:

The limits shall be as per IEC 61000- 4-2, 9(1) (both Contact discharge method and Air discharge method) as given below:

Test level:

Contact discharge		Air discharge	
Level	Test voltage (KV)	Level	Test voltage (KV)
4	8	4	15

Test Procedure: This test shall be conducted as per IEC 610004-2 for both requirements & unit shall comply of clause 9(1) of IEC 61000-4-2.

~~END OF SECTION 4~~

5.0 Electrical Requirements

5.1 Capacity:

5.1.1 Cell Capacity : When a cell is discharged at C/10 rate, it shall deliver 80% of rated capacity (corrected at 27°Celsius) before the cell voltage reaches 1.85V.The capacity (corrected at 27°Celsius) shall also not be less than C(rated capacity) and not more than120% ofC(rated capacity) when discharged to the cell voltage of 1.75V.

5.1.2 Mono-block Capacity: When a mono-block is discharged at C/10 rate, it shall deliver 80% of rated capacity (corrected at 27°Celsius) before the mono-block voltage reaches 11.1V. The capacity (corrected at 27°Celsius) shall also not be less than C (rated capacity) and not more than 120% of C (rated capacity) when discharged to the voltage of 10.5V.

5.1.3 Battery capacity : When a battery is discharged at C/10 rate, it shall deliver 80% of rated capacity (corrected at 27°Celsius) before any of the cells in the battery bank reaches 1.85V/cell. The capacity (corrected at 27°Celsius) shall also not be less than rated capacity and not more than 120% of the rated capacity before any cell in the battery bank reaches 1.75V/cell.

5.1.4 The capacity of the cell/mono-block/battery at discharge rates C/3 to C/120shall be as given below:

Rate of Dischar	Cell			Mono-Block		
	Discharge Current	Capacity expressed as % of C/10 Discharge rate	End cell voltag	Discharge Curren	Capacity expressed as % of C/10 Discharge rate	End cell voltag

ge			e	t		e
C/3	0.333C	71.7	1.74V	0.333C	75.0	10.44 V
C/4	0.25C	78.2	1.74V	0.25C	81.0	10.44 V
C/5	0.2C	83.3	1.75V	0.2C	85.0	10.5V
C/6	0.167 C	87.3	1.75 V	0.167C	91.0	10.5V
C/8	0.125 C	95.0	1.75 V	0.125C	95.0	10.5V
C/10	0.1C	100 to 120	1.75 V	0.1C	100 to 120	10.5V
C/20	0.05C	120.0	1.75 V	0.05C	120.0	10.5V
C/72	0.014 C	130.0	1.75 V	0.014C	130.0	10.5V
C/120	0.0083 C	150.0 (SPV Application only)	1.75 V	0.0083 C	150.0 (SPV Application only)	10.5V

5.2 Charging

5.2.1 The Cell/mono-block/battery shall be capable of being recharged from the fully exhausted condition (1.60V/cell or 9.6V/mono-block) at the specified float voltage. For test procedure refer clause 7.6.3.2 (A) of the GR.

5.2.2 The Cell/mono-block/battery design shall permit the charging of the battery at 2.45V/cell or 14.7V/mono-block, in constant voltage charging mode. For test procedure refer clause 7.6.3.2(B) of the GR.

5.2.3 Charging& discharging of the Cell/mono-block/battery at slow rate of C/72 or C/120 shall not affect the life and performance of the cell/mono-block/battery and shall not lead to sulphation. For test procedure refer clause 7.6.3.2 (C) of the GR.

5.3 **Float Voltage:** All the cells in a battery shall be designed for continuous float

operation at the specified float voltage throughout the life. Float voltage of each cell in the string shall be within 0.05V of the average float voltage/cell. For test procedure refer clause 7.6.3.3 of the GR.

5.4 **Voltages during Discharge** : The cell/mono-block/battery voltage shall not be less than following values, when a fully charged cell/mono-block/battery is put to discharge at C/10 rate:

S.No.	Test time	Cell	Mono-block
a)	After six minutes of discharge	1.98V/cell	11.88V/ mono-block
b)	After six hours of discharge	1.92V/cell	11.52V/mono-block
c)	After 8 hours of discharge	1.85V/cell	11.1V/mono-block
d)	After 10 hours of discharge	1.75V/cell	10.5V/mono-block

For test procedure refer clause 7.6.3.4 of the GR.

5.5 **Battery Discharge Tables:** The manufacturer shall provide the Tables & Graphs showing relation of the closed circuit voltage, conductance and the residual capacity of the mono-block/each cell in the battery string, when it is discharged to the end voltage of 10.5V/mono-block or 1.75V/cell at C/120, C/72, C/20, C/10, C/8C/6, C/5 rate of discharge, 1.74V/cell or 10.44V/mono-block at C/4 & C/3 rate of discharge. He shall also provide the table & graph showing the relation between the conductance & residual capacity of each cell or mono-block at all the above discharge rates.

5.6 **Transient Response (CoupDe Fouet):** When the battery is put to load at C/3, immediately after taking it off from the float, the voltage of any of the cells in the battery shall not fall below 1.89V, throughout the battery life. In case of mono-block it shall not fall below 11.34V in the above conditions. For test procedure refer clause
7.6.3.5 of the GR.

5.7 **Loss of Capacity during Storage**:

5.7.1 The loss in capacity during storage at an average ambient temperature of 35• · an average ambient temperature shall not be more than 50% & the Cell/mono- block/battery shall achieve 85% of its rated capacity within 3 charge/discharge cycles & full rated capacity within 5 cycles, after the storage period of 6 months. For test procedure refer clause 7.6.3.6 of the GR.

5.7.2 In case of battery, voltage of each cell in the battery string shall be within 0.05V of the average voltage throughout the storage period.

5.8 **Ampere Hour (Ah) Efficiency** : Shall be better than 90%.For test procedure refer clause 7.6.3.7 of the GR.

5.9 **Watt-Hour Efficiency**: Shall not be less than 80%. For test procedure refer clause 7.6.3.8 of the GR.

5.10 **Short Circuit:** External short Circuit(As per BS 6290), when applied, until its voltage drops to Zero, shall not cause fire or explosion of the cell/mono-block/battery and ~~External short Circuit, when applied to module,~~ there shall be immediate protection by BMS ~~and shall not cause fire or explosion of the module.~~ For test procedure refer clause 7.6.3.9 of the GR.

5.10.1 No Internal short circuit shall occur throughout the life of the cell/mono-block/battery due to active material shedding or separator material disintegration.

5.11 **Cell Matching:** Cell matching is essential for optimum life and performance of the battery. Parallel series connections of mono-block is not permitted as such this clause is not applicable to mono-blocks. For the purpose of cell

matching the following clauses shall be met. For test procedure refer clause 7.6.3.10 of the GR.

5.11.1 Voltage Matching :

5.11.1.1 Parallel cell matching: The difference between cell voltages in the cell module string, with the highest &lowest open circuit voltage shall be less than 0.02V. Throughout the discharge, the difference between the float voltages of cells having the lowest and the highest float/charge voltage in the cell module string shall be less than 0.02V. The average float voltage of each cell shall be within +/- 0.01V of the specified float voltage during float/charge.

5.11.1.2 Series cell Matching: The difference between cell voltages in a cell module & cell modules in the battery string, with the highest &lowest open circuit voltage shall be less than 0.1V. Throughout the discharge, the difference between the float voltages of cells having the lowest and the highest float voltage in the cell module/battery string shall be less than 0.1V. The average float voltage of each cell shall be within
+/- 0.05V of the specified float voltage during float & charge.

5.11.2 Capacity Matching

5.11.2.1 Parallel Capacity Matching: The difference between the highest and lowest cell capacities in a cell module string shall not be more than 4% of their rated capacity.

5.11.2.2 Series Capacity Matching: The difference between the highest and lowest cell capacities in a cell module & cell modules in a battery string shall not be more than 8% of their rated capacity.

5.11.3 **Conductance Matching:** Conductance of each cell/ cell module in the battery, when connected in series, shall be within +/-15%of the average cell/cell module conductance. Also, when the cells are connected in parallel to form a cell module, the conductance of all the cell in the cell module shall be within +/- 15% of the average conductance of the cells of the module. The conductance matching test certificate shall be obtained from any recognised or accredited Lab/Institution.

5.11.3

5.12 Expected Cell/Mono-block/Battery Life: The Cell/Mono-block/Battery for both Float& SPV applications shall be capable of giving more than 1400 DOD(up to 80%) cycles at an average temperature of 35 degree Celsius .For test procedure refer clause
7.6.4.4 of the GR.

END OF SECTION 5

6.0 Chemical Requirements

6.1 Electrolyte: The sulphuric acid and water used for the preparation of electrolyte shall conform to IS266 : and IS1069 : latest issues respectively.

6.2 Oxygen Recombination Efficiency: The recombination efficiency of cell/mono-block/ battery shall be higher than 95% for charge current of C/3.33 under normal working conditions. For test procedure refer clause 7.6.4.1 of the GR.

6.3 Cell/mono-block Pressure: The cell/mono-block pressure shall be sufficient for 99% gas recombination when working at 0.2C rate of charge & ambient temperature of 35 deg Celsius but in no case it shall be less than 3 psi. For test procedure refer clause
7.6.4.2 of the GR.

6.4 Gassing: The amount of hydrogen gas evolved from the cell/mono-block shall at no stage exceed 200 ppm of the volume of air of the room in which it is to operate. It shall be ensured that the percentage of hydrogen in the battery room is kept within 1% in the battery room. The manufacturer shall provide charts to show the volume of the room needed for mono-block/a string of 24 cell/12 Cell battery at C/10 rate of charge and C/3, C/4, C/5,C/6, C/8, C/10, C/20, C/72, C/120 rate of discharge respectively. Temperature dependent data in this regard shall also be provided. For test procedure refer clause 7.6.4.3 of the GR.

6.5 Grid Corrosion: Under normal operating conditions in India, grid corrosion shall not be more than 0.05mm/year. For test procedure refer clause 7.6.4.4 of the GR.

6.6 **Active Material Shedding :** Throughout its life, the battery or mono-block when working in the operating condition of C/10 rate of charge and C/6 rate of discharge in Indian ambient condition (average 35 deg Celsius) shall not lead short circuit due to shedding of cell/mono-block active material. For test procedure refer clause 7.6.4.4 of the GR.

6.7 **Positive Plate Growth:** It shall be less than 8% of the total plate area throughout the specified life. For test procedure refer clause 7.6.4.4 of the GR. The terminal seal design should be such that it should allow positive plate growth as per clause 3.6.

6.8 **Thermal Run-away :**While operating in the normal operating conditions the cell/mono-block or battery shall not lead to dry out, throughout the life of the battery. Manufacturer shall supply the necessary data to support the requirement. The cell/mono-block/battery shall not exhibit thermal runaway while working in the Indian environmental conditions (average working temperature of 35 degree Celsius) and at a charge rate of C/5. For test procedure refer clause 7.6.4.5 of the GR.

~~END OF SECTION 6~~

7.0 Methods to Test Cell/Mono-block/ Batteries

7.1 Scope: To ensure the compliance of all the requirements of this GR, the cells/mono- blocks/batteries shall be tested as detailed in the ensuing clauses.

7.2 Classifications of Tests:

7.2.1 Type Tests: These tests shall be carried out to prove conformity of the cell/mono- block with the requirements of this document. These tests are intended to prove the general quality and design of a given type of cell, mono-block or battery. Type tests on cell modules (formed by paralleling of basic cells to enhance the capacity) shall only be taken up after ensuring that the basic cell which has been used to make the module is type approved & the manufacturer has a valid Type Approval certificate for the basic cell.

7.2.2 Acceptance Test: Tests carried out on samples selected from a lot for the purpose of verifying the acceptability of the lot. These tests are further classified as follows:

7.2.2.1 Bulk Acceptance Tests: These tests are carried out by QA wing of BSNL to ensure that the each cell/mono-block/battery is in the compliance of the GR. QA shall conduct the tests to verify the performance of the cell/mono-block/battery as per the guidelines laid down by QA wing of BSNL, for the purpose. The sampling scheme and criteria for acceptance shall be in accordance with IS : 8320 :1982 or the guidelines laid by QA wing of BSNL.

7.2.2.2 Acceptance tests at Site: These tests shall be performed by the Acceptance

Testing wing of BSNL on each set of battery after installation at site.

7.3 **Test Instruments**: The manufacturer shall make available the test instruments/meters/set-ups required for the verification of the parameters of GR. The manufacturer shall also ensure that the instruments/meters have the valid calibration certificate. The minimum acceptable accuracy of test instruments is as below:

7.3.1 **Test Instruments**:

S. No.	Parameter	Minimum acceptable accuracy for measurement
1.	Temperature	0.1 Celsius
2.	Voltage	1.0 mV
3.	Current	1.0%
4.	Power	1.0%
5.	Pressure	1.0%
6.	Gas Volume	0.5%
7.	Gas Concentration	0.5%
8.	Time	0.5%
9.	Conductance	0.5%

10.	Storage Oscilloscope	60Mhz. (minimum)/Data logging Oscilloscope equipment that can record data at 1 Sec (min.) interval.
11.	Surge Generator along with Test facilities.	15KVA (minimum)

7.3.2 **Test Set-ups**

S. No.	Set-up	Minimum acceptable accuracy for measurement
1.	Battery Charging Plant	As per battery requirement
2.	Resistive Load	For discharge of battery
3.	Safety Valve Test Jig	To simulate the conditions for test.
4.	Temperature Regulated chamber for Ageing, Thermal Run-away & Loss of capacity Tests	Temperature regulated within 55· 5thinte +/- 3· /-hinted 75· 5-hintedreapacity Testshat can re + 3· 3hinted
5.	Short Circuit Test Jug.	As per requirement.
6.	Oxygen recombination efficiency, Cell/Mono-block Pressure, Gassing Test Jug.	As per test requirement.

7.3.3 **Temperature for Testing**: The temperature range within which the tests are carried out shall be 15-40· The temperature range within which the te

7.4 **Criteria of Selection for Type Tests** : For conducting type tests (excluding loss of capacity & ageing tests), two cells/mono-blocks/cell modules shall be chosen at random. The tests shall be carried out on both the cells/mono-blocks/cell module and be considered as having passed the requirements of this standard if no failure occurs in any of the tests. If any of the sample fails to comply any of the tests, the testing authority may once more, select fresh samples and subject them again to all the tests. If the cell/mono-block fails

again it shall be rejected.

Note: Type tests on cell modules(formed by paralleling of basic cells to enhance the capacity) shall only be taken up after ensuring that the basic cell which has been used to make the module is type approved & the manufacturer has a valid Type Approval certificate for the basic cell.

7.4.1 For Loss of Capacity during storage test, two separate cells/mono-blocks & for ageing test a single cell/mono-block shall be selected. After the selected cells/mono- blocks have achieved the rated capacity, they shall be put to test in accordance with the clause 7.6.3.6& 7.6.4.4.and be considered as having passed if it meets the GR requirements for the test. If any of the sample fails to comply the test, the testing authority may once more, select fresh samples and subject them again to the test. If the cell/mono-block fails again it shall be rejected.

7.5 **Testing of cell/mono-block/batteries**: The test to be conducted by TEC, QA and Acceptance wing of BSNL are as summarized below:

7.5.1 **Physical and Constructional verification:**

S. No.	Test	Type Test by TEC	Bulk Acceptance Test by QA	Acceptance Test At Site by T& D
1.	Design Practices	Yes	No	No
2.	Marking	Yes	Yes	Yes
3.	Packing	No	Yes	No
4.	Verification of Dimensions	Yes	Yes	Yes
5.	Stacking Arrangement	Yes	Yes	Yes
6.	Containers	Yes	No	No
7.	Cell/mono-block Cover	Yes	No	No
8.	Separators	Yes	No	No
9.	Regulation Valve	Yes	No	No
10.	Terminals	Yes	Yes	Yes
11.	Connectors	Yes	Verification	Verification
12.	Nuts & Bolts	Yes	Verification	Verification

13.	Flame Arrestors	Yes	Verification	No.

7.5.2 Quality & Operational Requirement Tests:

S. No.	Test	Type Test	Bulk Acceptance Test by QA	Acceptance Test At Site by T& D
1.	Quality Requirements	Yes	Yes	No
2.	Ambient Conditions Tests	Yes	No	No
3.	Fire Retardant	Yes	No	No
4.	Electro-static Discharge	Yes	No	No

7.5.3 Electrical Tests:

S. No.	Test	Type Test	Bulk Acceptance Test by QA	Acceptance Test at Site by T& D
1.	Capacity Test	Yes	Yes	Yes
2.	Ampere Hour Efficiency	Yes	Yes	Yes
3.	Watt Hour Efficiency	Yes	Yes	Yes
4.	Charging	Yes	Yes	Yes
5.	Float Voltage	Yes	Yes	Yes
6.	Voltage During Discharge	Yes	Yes	Yes
7.	Transient Response	Yes	Yes	Yes
8.	Loss of Capacity during Storage	Yes	No	No
9.	Cell/mono-block Matching:	No	Yes (as per QA procedure)	Yes
	Voltage/capacity	N		Yes
	Matching:	o	- do -	No
	Conductance	Y es	Yes	
	Matching:	~~N o~~		
10.	Battery Reliability	No	Yes	No

7.5.4 Chemical Tests

S. No.	Test	Type Test	Bulk Acceptance Test by QA	Acceptance Test At Site by T& D
1.	Oxygen Recombination efficiency	Yes	Yes	No
2.	Cell/mono-block Pressure	Yes	Yes	No
3.	Gassing	Yes	Yes	No
4.	Thermal Run-away	Yes	No	No
5.	Ageing/Life	Ye	No	No
5(a	Cycle Grid	s	No	No
5(b)	Corrosion	Ye	No	No
	Positive Plate Growth	s		
		Yes		

7.5.5 Manufacturer, before transporting the mono-block/battery shall give it a freshening charge and shall put a date of freshening charge on it so that full 6 months are available for installation and commissioning.

7.5.6 On Installation of mono-block/battery at site, before giving freshening charge, the installer along with A/T shall verify for cell matching requirement of clause 1.2.2.7 and also ascertain the actual loss of capacity during the period of storage.

7.6 Test Procedure

7.6.1 Physical and Constructional verification

7.6.1.1 Design Practices: It shall be verified that the design of the cell/mono-block/battery is in compliance with the provisions of the clause 3.1.

7.6.1.2 **Stacking (mounting) Arrangement:** For type testing of cell it shall be verified that it is suitable for horizontal stacking. In case of mono-block it shall be as per manufacturers design. Type of stacking shall clearly be mentioned in the Type Approval Certificate (TAC). The Bulk & Acceptance tests shall be conducted in the stacking arrangement as per purchase order.

7.6.1.3 **Tests for Materials:** Test for materials of construction shall be carried out as below:

7.6.1.3.1 **Containers and covers:**

Type of Container Material: The material of container shall be designated by any one of the following letters as the case may be:

Polypropylene : PP

Acrylonitrile-Butadiene-Styrene :
ABS

The container & cover material shall comply for the following:

Sr. No.	Name of test	Test method (Spec. ref.)	Requirement
1.	Plastic yield	IS: 1146:1981 (appendix-D)	Not > 5 mm
2.	Acid Resistivity	IS:1146:1981	Change in mass shall not be > 2mg/ cm^2 for 10cmX6.5cm
3.	Impurities of Unpainted surface a) Iron b)Chlorine c) Manganese	IS:1146:1981	Not > 0.16 mg/cm^2 Not > 0.08 mg/cm^2 Not > 0.0016 mg/cm^2

4.	Density	ASTM D-792-1986	Shall comply the requirement of the standard for the material.
5.	Tensile Strength	ASTM D-638-1989	220 kg/cm^2 minimum
6.	Flexurol Modulus	ASTM D-790-1986	8000 kg/cm^2 minimum
7.	Izod impact Strength	ASTM D - 256 - 1988	Shall comply the requirement of the standard for the material.
8.	Melt flow Rate	ASTM D -1238-1988	Shall comply the requirement of the standard for the material.
9.	Heat distortion	ASTM D - 648-1988	Test condition : Pressure: 455 KPa (66 psi) Limit : 85 ^{o}C minimum
10.	High voltage test	IS 1146:1981	Shall comply the requirement of the standard.

These tests may be conducted at any recognised test Lab.

- It shall be verified by visual inspection that the cell/mono-blocks are symmetrical without any bluster or crack or roughness.
- The cell/mono-block containers and covers shall show no cracks or deformity when test for cell/mono-block pressure as per clause 7.6.4.2 is performed.

The Cell containers shall be housed in epoxy painted steel trays. The steel trays shall be so designed as to be suitable for horizontal stacking. In case of mono-block it shall be in horizontal or vertical stacking as per manufacturers design

- The container shall be fire retardant and shall be in compliance with clause 7.6.2.2.2.
- It shall be verified that all the Marking as per clause 2.3 and visible in the

installed condition. The dimensions are as per the manual diagrams.

- Gauge of steel tray should be enough to withstand the load of the battery. The gauge of tray for each capacity shall be approved by QA wing of BSNL.
- **The material shall be resistant to sulphuric acid:** A test piece of cell/mono-block material of the size 10cm*6.5cm shall be dipped in Sulphuric Acid of sp. gr. 1.30 for 28 days at 60 +/- 2.5 deg Celsius.

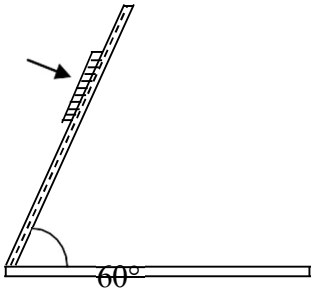
Requirements:

1. There shall be no blistering, warping or distortion of the test piece.
2. The change in mass shall not be more than 2.0 mg/cm square

7.6.1.3.2 Separators:

- Wicking: The total wicking height in separator shall not be less than 630mm in 24hours.
- The uncompressed water absorption of the separator shall be at least 5 grams of water/gm of separator material.
- Acid Retention test : Acid Retention capacity

Separator shall be verified as follows :(10cm X 10cm}



- Take a 10 cm X 10cm size separator as a specimen from the separators used by the manufacturer in his VRLA Batteries.
- Take its Dry weight accurately (say W1)
- Soak the specimen in the electrolyte used in the Batteries for a period of 30 minutes.
- Keep the separator on a grooved inclined surface with angle of inclination, 60 degrees to the horizontal plane.

- Allow the excess electrolyte to flow through the grooves for one hour in a closed atmosphere.
- Weigh the wet specimen accurately (say W2).
- The acid retention capacity of the separator is : (W2 –W1)/W1.

Requirement: Shall be between 7.5 and 10 grams/gram of separator.

7.6.1.3.3 Regulating Valve:

- Five regulating valves shall be selected for the test.
- Each valve shall be tested five times for its functioning.
- The venting shall only occur through the valves.
- Valve shall be subjected to pressure release test in compliance of clause 3.5.
- The resealing of valve shall take place before the internal pressure drops to the value necessary for 99% gas recombination in compliance of clause 6.3.

7.6.1.3.4 Terminal Post:

- Both +ve and -ve Terminals shall be clearly and distinctly marked.
- It shall comply all the requirements of the clause 3.6.
- The sealing of terminal post shall neither melt or deform when a short circuit test as per clause 5.10 is performed on the cell/mono-block.

7.6.1.3.5 Connectors:

- The connectors shall be in compliance with the requirements of the clause 3.7

7.6.1.3.6 Nuts Bolts and washers :

- Nuts, bolts & washers used shall be of copper, brass or stainless steel. Copper or brass nuts, bolts & washers shall be effectively lead coated to prevent corrosion. Stainless steel nuts, bolts & washers can be used without lead coating. Nuts, bolts & washers used shall be resistant to sulphuric acid.
- Nuts, bolts and washers shall be tested by immersing in 30% concentrated sulphuric acid for not less than 24 hours. The acid shall be clear at the end of this period.
- Nuts, bolts & washers of other than steel shall comply the lead coating requirement of BIS 6848 latest issue (Lead coating shall not be less than 0.025mm).

7.6.2 Quality Requirements:

7.6.2.1 Manufacturing of batteries as per ISO 9001:201508

It shall be verified and ensured that the VRLA Batteries are manufactured in accordance with the International Quality Standard ISO 9001:2008 for which the manufacturer has been duly accredited.

7.6.2.2 Quality Requirements:

It shall be ensured that the requirement of clause 4.2 is fully complied with. However the Quality assurance tests shall be conducted by QA wing of BSNL by conducting all the tests listed for Bulk acceptance tests.

7.6.2.3 Disposal of unserviceable Batteries

It shall be ensured that the manufacturers has the provisions to dispose the unserviceable batteries in accordance with Gazette Notification issued by Ministry of Environment & Forests "Extraordinary Part-II-Section-3-Sub-section(ii) No. 311 issued at New Delhi May 16, 2001" and also complies the provisions of clause 4.2.5 of this document. It shall also be ensured that the manufacturer has a valid ISO 14001 certificate.

7.6.2.4 Operational Requirements:

7.6.2.4.1 Ambient Conditions: It shall be ensured that the cell/mono-block complies the requirements of Clause 4.3.1. These tests may be conducted at any Environmental Test Lab having the facilities for the conduction of the all the required tests as per QM-333 Category B2 including Vibration tests as per QM-333.

7.6.2.4.2 Fire Retardant: Cell/mono-block shall comply the requirements of clause 4.3.3. These tests may be conducted at a test lab having the facility for the test.

7.6.2.4.3 Electro-Static Discharge:

An electro-static discharge of 15KV between one of its terminals & body of the cell/mono-block shall neither explode nor burn it. The cell/mono-block shall be tested in accordance with IEC-61000-4-2.

7.6.2.4.4 Battery Reliability: These tests shall be conducted by QA wing of BSNL by performing C/10 capacity tests with 22 cells / 11 cells shall ensure the compliance of the clause 4.4

Requirement: During the discharge test, the voltage of the above battery at the end of:

4 hours shall be higher than 44.4V/22.2 V
6 hours shall be higher than 42.3V / 21.1 V & none of the cells shall be below 1.92V.

Mono-Block reliability: In case of mono-blocks it may conducted by TEC by bypassing one cell & taking the capacity test.

Requirement: During the discharge test, the voltage of the above mono-block at the end of: - 4 hours shall be higher than 10.1V
- 6 hours shall be higher than 9.6V.

7.6.3 Electrical Tests

7.6.3.1 Tests for Capacity:

- After standing on open circuit for not less than 12 hours and not more than 24 hours, from the completion of a full charge, the cell/mono-block shall be discharged through a suitable variable resistance at a constant current of I = C/10 amperes. The discharge shall be stopped when the closed circuit voltage falls to :

a) In case of cell: 1.75V
b) mono-block:10.5V
c) In case of Battery: Voltage of any of the cell/cell module in the string falls to 1.75V.

- The Capacity of the cell/mono-block/battery shall also be calculated, when the voltage of the cell/mono-block/any of the cell in the battery has reached 1.85V/cell or 11.1V/mono-block.

This capacity shall not be less than 80% of the rated capacity.

Note: Capacity test during Type Tests shall be conducted on a cell/mono-block while for Bulk &Acceptance tests it shall be conducted on a mono-block/battery.

- During the discharge at C/10 rate, voltage and current of the cell/mono- block/each cell of the battery shall be recorded :
  - every 5 minutes for first 15 minutes
  - at an hourly interval for the next 8 hours
  - every 15 minutes thereafter up to the end voltage.
- The discharge current shall be maintained within 1% of the specified rate of discharge.
- The time in hours elapsing between the beginning and end of discharge shall be taken as period of discharge.
- The average temperature of the electrolyte during discharge shall be the average of the temperatures of the electrolyte noted at regular periodic intervals depending on the rate of discharge. This can be done by measuring the temperature of the cell/mono-block terminal as it will be almost the same as that of electrolyte.
- Unless or otherwise agreed to, the capacity test as described above is normally to be treated as the test discharge for the purpose of the acceptance of the cell/mono-block.
- On the first discharge the cell/mono-block/battery shall give, not less than 85% of the rated capacity.
- The cell/mono-block/battery shall achieve 100% of its rated capacity within 5 discharges.
- Once the rated capacity has been met& stabilised on any discharge (same capacity in two consecutive discharge cycles), further discharge cycles for capacity shall not be continued.

Capacity Calculations:

The capacity shall be corrected at 27 deg. Celsius by the following

formula: The capacity at 27 deg Celsius = C_t + (C_tXR(27-t))/100

Where: C_t is observed capacity at t deg Celsius

*R is variation factor

t = Average cell/mono-block terminal temperature in deg Celsius.

*R (Temperature Correction Factor) versus Rate of Discharge

Discharge Rate	C/10& above	C/9	C/8	C/7	C/6	C/5	C/4	C/3
Value of R	0.43	0.45	0.47	0.50	0.54	0.58	0.62	0.68

Note: Capacity-temperature correction is not a true linear relationship.

Example: Capacity C measure at 24 deg Celsius = 1000 AH

Capacity at27° Celsius = 1000+(1000*0.43*(27-24))/100=1012.9AH

Requirements: The actual capacity corrected to 27°Celsius shall not be less than as given in clause 5.1.1, 5.1.2 &5.1.3 respectively of this GR within5 cycles & not more than 120% of the rated capacity.

Note-1: Test for capacity shall also carry out at rates other than C/10 rate of discharge. Capacities at various rates of discharge to the corresponding end cell/mono-block **voltages** shall comply with the provisions of the clause 5.1.4

Note-2: For the purpose of acceptance, the capacity test shall be carried out at one rate only & the cell/cell module/mono-block/battery shall be put to use only when it has achieved its rated capacity.

7.6.3.1.1 **Capacity Test at other Discharge Rates:** The capacity tests at discharge rates C/3, C/4, C/5, C/6, C/8, C/20, C/72and C/120 shall be performed and in all these tests the capacity shall comply the requirements of the GR.

7.6.3.2 **Charging:**

A. Charging of Cell/mono-block at float voltage from fully discharged condition :

- The cell/mono-block/battery shall be charged/discharged in Horizontal position only while mono-blocks may be charged/discharged in horizontal or vertical positions as per the manufacturer's design.
- The cell or mono-block shall be discharged to an end voltage of 1.6V/cell or 9.6V/mono-block. In case of battery when any of the cell of the battery string reaches to an end voltage of1.6V/cell
- Charge the cell/battery at 2.25V/cell& mono-block at 13.5V/mono-block for 72 hours or till the current drawn by the cell/mono-block/battery remains within 5% for at least two hours.
- Ascertain the capacity of the cell/mono-block/battery by discharging it at C/10 rate as conducted for capacity test in clause 7.6.3.1above and calculate the capacity

Requirement: At the end of this test ,the capacity of the cell/mono-block/battery shall be 100% of its rated capacity.

B. Charging of Cell/mono-block at a voltage 2.45V/cell or 14.7V/mono-block:

- Charge the cell/battery at a float voltage of 2.45V/cell or mono-block at 14.7V for 72 hours or till the current being drawn by the cell/mono-block/battery has stabilised.

Requirement: The temperature of the cell/mono-block shall stabilise with in first 4 hours & there shall be no damage to the cell/mono-block.

C. Sulphation Test:

- Discharge at a rate of C/80 for a period of 24 Hrs.
- Leave the battery on open circuit for 120 Hrs (5 days)
- Recharge at C/20 for 4 Hours followed by C/80 for 12 Hrs.
- Discharge at C/120 rate to an end voltage of 1.9V/cell or 11.4V/mono-block)

Requirement: The cell/mono-block/battery should give at least 108 hours

7.6.3.3. **Float Voltage (for battery) :** The battery shall be kept on float operation for period as specified by the manufacturer, but not more than seven days. After the period of seven days the voltage of each cell in the battery shall be within 0.05V of the average voltage/cell.

7.6.3.4 **Voltage During Discharge:** The cell/mono-block need not be discharged specifically for this test. For the purpose of this test the voltages shall be obtained from the log sheets for capacity tests in which cell/mono-block meets the rated capacity.

Requirement: The closed circuit voltage of cell/mono-block shall not be below the specified voltage at every stage of discharge.

7.6.3.5 **Transient Response (Coup De Fouet):**

- Charge the Cell/mono-block/battery as per manufacturers guidelines
- Connect the Cell/mono-block/battery to the charger in parallel with the load equal to C/3 rate of discharge.
- Shut down the charger so that the load is instantly transferred to cell/mono- block/battery.
- Record the dip in voltage due to transfer of load from charger to cell/mono-block/ (each cell in case of battery).

Requirements: Voltage of the cell/mono-block/battery in first ten minutes shall not dip below 1.89V/cell or 11.34V/mono-block.

Note: Storage Oscilloscope may be used for this test to record the dip if any.

7.6.3.6 **Loss of capacity during Storage:** This test shall be carried out on the two cell/mono-blocks which have successfully passed the capacity test.

Step-I

- Capacity shall be verified by performing capacity test &the capacity shall be recorded as “C”.
- The cell/mono-blocks shall be fully recharged as per manufacturer's instructions.
- After a complete recharge, cleaning & wiping the surface dry, the cell/mono-blocks shall be left on open circuit for a period of 6 months without disturbance in chamber maintained at a temperature of 35 deg. Celsius.
- After the storage period of 6 months the cell/mono-block shall be discharged in accordance with capacity tests. The value of capacity measured after storage is denoted by "C_1".
- The loss of capacity S expressed as a percentage is calculated as: $S = ((C - C_1)/C) X 100$

Requirement: The loss in capacity, as calculated above shall be less than 50%.

Step-II

- Recharge the cell/mono-block as per manufacturers instructions.
- Perform the capacity test at C/10 rate of discharge

Requirement: The capacity achieved shall be more than 85% of “C” within first three such cycles.

Step-III

Repeat the charge discharge cycles till the rated capacity “C” is achieved.

Requirement: Rated capacity “C” shall be achieved in 5 cycles.

7.6.3.7 Ampere-hour Efficiency:

- Fully charge the cell/cell module/mono-block/battery as per manufacturers instructions
- Discharge the cell/cell module/mono-block/battery at I = C/10 amperes to an end voltage of 1.75V/cell or 10.5V/mono-block.
- Calculate the exact number of ampere-hours (AH) delivered.
- Recharge the cell/cell module/mono-block/battery for the same number of AH at the same current.
- A second discharge shall be made to the same cut-off voltage as before.
- The efficiency of the cell/cell module/mono-block/battery is then calculated as : ((AH delivered during the second discharge)/ (AH put in on charge))*100.

Requirement: The ampere-hour efficiency when calculated as above shall not be less than 90%.

7.6.3.8 Watt-Hour Efficiency:

- Watt hour efficiency shall be calculated by multiplying the AH efficiency by the ratio of average discharge and recharge voltage.

- The value of discharge and recharge voltage shall be calculated from the log sheets for ampere-hour efficiency tests.

Requirement: Watt hour efficiency when calculated as described above shall not be less than 80%.

7.6.3.9 Short Circuit Test:

- Take a fully charged cell/mono-block to be tested.
- Apply a short between its terminals as per BS 6290, till its voltage falls to Zero.

Requirement: The test shall not lead to fire or bursting of the cell/mono-block.

7.6.3.10 Cell Matching:

A. Parallel Cell matching (to be conducted by TEC at the time of Type Testing, by QA & T&D Circle during PQT/BULK & Acceptance testing respectively)

- Take a fully charged cell Module and measure the Open circuit voltage of each cell.
- Discharge the module at C/10 rate & measure the closed circuit voltage periodically till the voltage of any of the cell in the string reaches 1.75V.
- Calculate the capacity of each cell in the string.
- Recharge the module at C/10 rate& measure the closed circuit voltage of each cell periodically till it is fully charged.

Requirement: The Voltage and capacity of each cell in the cell module shall be in compliance with the requirements of the Clause 5.11.1.1 & 5.11.2.1

B. Series matching(to be conducted by QA & T&D Circle at the time of bulk testing & Acceptance testing respectively)

- Take a fully charged battery & measure the Open circuit voltage of each cell/cell module.
- Discharge the battery at C/10 rate and measure the closed circuit voltage periodically till the voltage of any of the cell/cell module in the string reaches 1.75V/cell.
- Calculate the capacity of each cell/cell module in the string.
- Recharge the battery at C/10 rate & measure the closed circuit voltage

periodically till it is fully charged.

Requirement: The Voltage and capacity of each cell/cell module in the battery shall be in compliance with the requirements of the Clause 5.11.1.2 & 5.11.2.2.

C. **Conductance matching (Clause 5.11.3):** Conductance of each cell/ cell module in the battery, when connected in series, shall be within +/-15%of the average cell/cell module conductance. Also, when the cells are connected in parallel to form a cell module, the conductance of all the cell in the cell module shall be within +/- 15% of the average conductance of the cells of the module.

a) Parallel Cell matching(to be conducted by TEC at the time of Type Testing, by QA during PQT/BULK testing respectively)

- Take a fully charged cell Module and measure the Open circuit voltage and conductance (off line) of each cell.
- Discharge the module at C/10 rate and measure the voltage and conductance (off-line, i.e. after isolating the battery from load and allowing the voltage to stabilise) of each cell at the end of Eight hours and at the end of discharge (when any of the cell in the string has reached 1.75V (while on discharge)).
- Compute and tabulate the conductance readings of each cell in the string.

Requirement: The conductance of each cell in the cell module shall be in compliance with the requirements of the Clause 5.11.3

b) Series matching (to be conducted by QA during bulk testing)

- Take a fully charged battery & measure the Open circuit voltage and conductance (off- line) of each cell/cell module.
- Discharge the battery at C/10 rate and measure the voltage and conductance(off-line, i.e. after isolating the battery from load and allowing the

voltage to stabilise) of each cell at the end of Eight hours and at the end of discharge (when any of the cell/cell module in the string has reached 1.75V(while on discharge)).

- Compute and tabulate the conductance readings of each cell/cell module in the string.

Requirement: The conductance of each cell/cell in the cell module in the string shall be in compliance with the requirements of the Clause 5.11.3

Date of Effect: This amendment shall be applicable with immediate effect.

Remarks: As no TAC has been issued against the GR No. GR/BAT-01/03 MAR 2004,to which this amendment has been issued, therefore no incremental tests are proposed against this amendment. Category for incremental Test Fee against this amendment: Not applicable

7.6.4 Chemical Tests

7.6.4.1 Oxygen Recombination Efficiency:

The test shall be conducted as

follows:

1. Take the fully formed cell/mono-block
2. The fully charged Cell/mono-block/battery shall be overcharged at a current of C/100 for 96 consecutive hours.
3. Install the discharge gas detector.
4. Within one hour after completion of (1), the cell/mono-block/batteries shall be continuously charged at a current of C/200 A for further 24 hours.

a) Immediately after completion of 24 hours, collection of gases emitted shall be started.
b) Collect the emitted gases for one hour.
c) During the collection time, the ambient temperature of the cell/mono- block/batteries shall be 27 +10 Deg Celsius, and the outlet of the pipe for the gas collector leading from the cell/mono-block/batteries shall not be more than 50 mm below the water.

Then, the volume of gases emitted (expressed at atmospheric pressure of 101.3kPa at 25· hen, the volume of gases emitted (expressed at

V = P/101.3 *298/(t+273) *v/Q*1/n

Where:

Volume of gases emitted expressed at an atmospheric pressure of 101.3kPa at 25· t 25kParic)lume of gases emitted (expressed at
P : Atmospheric pressure during measurement (kPa)
t : Ambient temperature of the collector (degree
Celsius) v : Amount of emitted gas collected (ml)
Q : amount of electricity put in during collection of gasses in

AH. The gas recombination efficiency shall be calculated by

the formula: Gas recombination efficiency (%) = (1-

V/684)*100

Where: 684 is theoretical volume of gases emitted per AH at atmospheric pressure 101.3kPa at 25· tmospher

7.6.4.2 Cell/mono-block Pressure:

- Take the fully formed cell/mono-block
- Replace the Valve with a Pressure Gauge
- Create the conditions so that the internal cell/mono-block pressure is equal to 3 times the highest pressure specified for operation of the pressure valve.
- Maintain this pressure for 24 hours.

Observation:There shall be no change in pressure. This shall not cause any gas leakage, any deformity in the cell/mono-block.

7.6.4.3 Gassing:

- Arrangement shall be made to collect the gasses discharged during its operation in accordance with clause 6.4.
- The gasses collected shall be analysed for the percentage of hydrogen with the data & charts provided by the manufacturer.

Requirement: % of hydrogen shall be within the specified limits.

7.6.4.4. Service Life or Ageing Test:

To ascertain the service life the accelerated ageing test shall be performed as follows :

Part-I

- The cell/mono-block shall be charged as per the procedure explained for capacity test.
- The cell/mono-block shall be placed in a temperature controlled chamber maintained at a temperature of 55+/-3 deg Celsius till it has attained the

chamber temperature.

- The cell/mono-block shall be maintained at this temperature throughout the test.
- The cell/mono-block shall be discharged at a rate equal to C/3for 3 Hours followed by a charge at constant voltage of 2.33V/cell or 13.98V/mono-block(equivalent to 2.4V/cell or 14.4V/mono-block at 35 deg Celsius) limited to a charging current equal to 40% of its rated capacity for 9 hours.
- The above charge discharge cycle shall be repeated 25 times.
- This shall be treated as one life unit.
- The cell/mono-block shall be discharged at a rate equal to 0.333 X C (Actual capacity observed during capacity test) for the time calculated as per Annexure 3.

Part-II

- After bringing the Cell/mono-block to ambient temperature the capacity test shall be conducted. If the capacity obtained at 27 deg Celsius is higher than 80% of its original test capacity, the next life unit test, as explained in part-I, shall be performed.
- ~~The cell/mono-block shall be discharged at a rate equal to 0.333 X C (Actual capacity observed during capacity test) for the time calculated as per Annexure 3.~~

Part-I followed by part-II shall be repeated till the capacity falls below 80% of its original test capacity.

The life of the battery may be arrived at by plotting the test results on Arrhenius Graph and extrapolating them.

Requirement: Minimum seven such life units shall be successfully completed before the capacity falls below 80% of its original test capacity.

Note: This test shall be conducted on a cell/mono-block. For a cell module formed by paralleling the cell to enhance capacity this test need not to be

repeated.

The following shall be verified after the completion of the Ageing test for the compliance of the respective clauses:

1. Grid Corrosion (clause 6.5)
2. Active material Shedding (clause 6.6)
3. Positive Plate Growth (clause 6.7)

7.6.4.5 Thermal Runaway:

This test shall be performed on a fully charged cell/mono-block

- The cell/mono-block shall be placed in a constant temperature oven or chamber at 75 deg Celsius
- When the cell/mono-block surface temperature has stabilised at 75 deg Celsius, it shall be continuously charged at a constant voltage of 2.33V/cell or 13.98V/mono-block for 72 hours.
- Charging current, voltage and surface temperature of the cell/mono-block shall be measured.
- The test shall be continued till the charging current and surface temperature become stable.
- If any sign of thermal runaway appears the test shall be immediately discontinued.

~~END OF SECTION 7~~

~~6.0~~8.0 Safety Requirements:

~~7.1~~ The equipment shall conform to relevant safety requirements as per IS 16894 (Part 4) : 2018 IEC 62485-4 : 2015 as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024'.

~~Following tests are to be carried out as per UL 1642/ UL 1973, or IEC 62619:~~

~~a. Charging procedures for test purposes~~

~~b. Continuous charging at constant voltage/Overcharge Test (cells)~~

~~c. Temperature Cycling Test~~

~~d. External short-circuit (cell)~~

~~e. External short-circuit (battery)~~

~~f. Free fall/ Drop test~~

~~g. Thermal abuse (cells)~~

~~h. Crush (cells)~~

~~i. Over-charging of battery~~

~~j. Forced discharge (cells)~~

~~k. Vibration~~

~~l. Mechanical shock/Impact test~~

~~m. Design evaluation – Forced internal short-circuit (cells)~~

9.0 Environment Requirements:

~~7.15~~ Each cell in VRLA battery shall be equipped with a Flame Arrestor to defuse the Hydrogen and oxygen gas escaped during charge and discharge and the flame arrestor is in compliance with the requirements of relevant clause of 14016:2010 (old no. QM-333:2010).

Each system shall be capable of operating in conditions conforming to TEC GR No.14016:2010 (old SD QM-333 Issue March 2010) category B2 of QA Wing of BSNL.

Chapter 2

Guidelines for the purchaser/user

10.0 Guarantee: The manufacturer supplying the cells/mono-block/batteries as per this GR shall be responsible to replace/repair free of charge, the cell/mono-block/battery becoming faulty, owing to defective workmanship or material, within 18 months from the date of dispatch or 12 months from the date of commissioning of the cell/mono-block/battery into actual service whichever is earlier.

10.1 Packing: Packing shall be done in accordance with the latest guidelines issued by QA wing of BSNL under the supervision of QA staff.

10.2 Condition of Supply : To ensure the procurement of the correct type of cells/mono-blocks/batteries, the user shall furnish the following information regarding his requirements at the time of inquiry or order :

1. Application of the battery : Float/SPV
2. Number of identical batteries required in parallel
3. Number Cell per battery
4. The Rate of Charge and discharge at which the Mono-block/batteries are to work.
5. Capacity of the Mono-block/battery in Ampere Hours at C/10.
6. Type of stacking arrangement required depending on floor loading and space available: number of tiers/stack for battery.
7. Type of specific stand required if any.
8. Proposed location of Installation and Ultimate consignee
9. Probable date of commissioning of the mono-block/battery.
10. Accessories and spares required, if any
11. Any other special condition/requirement, if any

The manufacturer shall furnish the following information:

1. Capacity of the Mono-block/battery at C/10 rate.
2. Manufacturers‟ name
3. Method of connections between the cells, whether Bolted or Burnt.
4. Type and Material of the container
5. Material of the separator.
6. Overall dimensions & weight of each complete cell
7. Space and floor loading in the desired configuration.
8. Specific order if any in which the cells are to be arranged.
9. Procedure for monitoring the health of mono-block/battery during maintenance and preventive measures required.
10. Measures required to be taken, at the site of installation . Showing the state of discharge and procedure for recoupment thereof .

The other terms and conditions of supply shall be subject to agreement between the two

Terminology

The terms given in IS:1885 (Part-8)-1986 are applicable to this document also. The following additional terms shall also apply to this document.

Absorption: The taking up or retention of one material or medium by another by chemical or molecular action.

Activated Stand Life : The period of time, at a specified temperature, that a cell/mono-block/battery can be stored in the charged condition before its capacity falls below a specified level.

Activation: The process of making a reserve cell/mono-block/battery function

Ageing: Permanent loss of capacity due to either repeated use or the passage of

time.

Ambient Temperature: The average temperature of the surroundings.

Ampere-Hour Rating : The rating assigned to the cell/mono-block shall be the capacity expressed in ampere-hours (after correction at 27 deg Celsius) and stated by manufacturer to be obtainable when the cell/mono-block is discharged at C/10 to a final end voltage of 1.75 volts.

Ampere-hour (Ah) Efficiency : The percentage ratio of the output of the secondary

cell/mono- block or battery, measured in ampere-hours, to the input required to restore the initial state of charge, under specified conditions.

Available Capacity : The total capacity, Ah or Wh, that will be obtained from a cell/mono- block or battery at defined discharge and other specified discharge rates or operating conditions.

Capacity : The total number of ampere-hours or watt hours that can be withdrawn from a fully charged cell/mono-block or battery under specified conditions or discharge.

Capacity Fade : Gradual loss of capacity of a secondary battery with cycling.

Capacity Retention : The fraction of the full capacity available from a cell/mono-block/battery under specified conditions of discharge after it has been stored for a period of time.

Charge Acceptance : Willingness of a battery or cell/mono-block to accept charge. May be affected by cell/mono-block temperature, charge rates and state of charge.

Closed Circuit Voltage (CCV) : The difference in potential between the terminals of a cell/mono-block or battery when it is discharging.

Conditioning : Cycle charging and discharging of a battery to ensure that it is fully formed & fully charged. Sometimes indicated when a battery is first placed in service or returned to service after prolonged storage.

Constant Current Charge : A method of charging the battery using a current having little variation.

Constant Voltage Charge : A method of charging the battery by applying a fixed

voltage, and allowing variations in the current. Also called constant potential charge.

Continuous Test: A test in which a cell/mono-block or battery is discharged to a prescribed end-point voltage without interruption.

Counter Electromotive Force: A voltage opposite to the applied voltage. Also referred to as back EMF.

Current Density: The current per unit active area of the surface of an electrode.

Cut-off Voltage: The cell/mono-block or battery voltage at which the discharge is terminated. Also called end voltage.

Cycle : The discharge and subsequent or preceding charge of a secondary battery such that it is restored to its original conditions.

Cycle Life : The number of cycles under specified conditions which are available from a secondary battery before it fails to meet specified criteria of performance.

Deep Discharge: Withdrawal of at least 80% of the rated capacity of a cell/mono-block or battery.

Depth of Discharge (DOD) : The ratio of the quantity of electricity (usually in ampere- hours) removed from a cell/mono-block or battery on discharge to its rated capacity.

Efficiency : The ratio of the output of a secondary cell/mono-block or battery to the input required to restore it to the initial state of charge under specified conditions.

Electrolyte: The medium which provides the ion transport mechanism between the positive and negative electrodes of a cell/mono-block.

End Voltage: The prescribed voltage at which the discharge(or charge, if end-of-charge voltage) of a cell/mono-block or battery may be considered complete (also cut off voltage).

Energy Density : The ratio of the energy available from a cell/mono-block or battery to its volume (Wh/L). Also used on a weight basis (Wh/Kg).

Fast Charge : A rate of charging which returns full capacity to a rechargeable battery, usually within an hour.

Float Charge: A method of maintaining a cell/mono-block or battery in a charged condition by continuous, long-term constant-voltage charging, at a level sufficient to balance self- discharge.

Gas Recombination: Method of suppressing hydrogen generation by recombining oxygen gas on the negative electrode as the cell/mono-block approaches full charge.

Half-Cell/mono-block : An electrode (either the anode or cathode) immersed in a suitable electrolyte.

Hourly Rate : A discharge rate, in amperes, of a cell/mono-block or battery which will deliver the specified hours of service to a given end voltage.

Internal Resistance : The opposition or resistance to the flow of an electric current within a cell/mono-block or battery, the sum of the ionic and electronic resistance of the cell/mono- block components.

Life : For rechargeable batteries, the duration of satisfactory performance, measured in years float life) or in the number of charge/discharge cycles (cycle life).

Load : The term used to indicate the current drain.

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

Maintenance-Free Battery : A secondary battery which does not require periodic "topping up" to maintain electrolyte volume.

Memory Effect : A phenomenon in which a cell/mono-block, operated in successive cycles to the same, but less than a full, depth of discharge experiences a depression of its discharge voltage and temporarily loses the rest of its capacity at normal voltage levels.

Open-Circuit Voltage (OCV) : The potential or voltage of a cell/mono-block or battery when it is at the surface of the electrode.

Overcharge : The forcing of current through a cell/mono-block after all the active material has been converted to the charged state. In other words, charging continued after 100% state of charge is achieved.

Over discharge : Discharge past the point where the full capacity of the cell/mono-block has been obtained.

Over voltage : The potential difference between the equilibrium potential of an electrode and that of the electrode under an imposed polarisation current.

Oxygen Recombination : The process by which oxygen generated at the +ve plate

during charge is reacted at the -ve plate.

Parallel : Term used to describe the interconnection of cell/mono-blocks or batteries in which all of the like terminals are connected together. Parallel connections increase the capacity of the resultant battery as follows :

$C_p = n \times C_u$; Where C_p is the resultant capacity, n is the number of cell/mono-blocks or batteries connected in parallel & C_u is capacity of the unconnected cell/mono-block or battery.

Rated Capacity: The number of ampere-hours a cell/mono-block or battery can deliver under specific conditions (rate of discharge, end voltage, temperature): usually the manufacturer's rating.

Recombination : A term used in a sealed cell/mono-block construction for the process whereby internal pressure is relieved by reaction of oxygen with the negative active material.

Reference Electrode : A specially chosen electrode which has a reproducible potential against which other electrode potentials may be referred.

Self-Discharge : The loss of useful capacity of a cell/mono-block or battery due to internal chemical action (local action).

Semi-Permeable Membrane : A porous film that will pass selected ions.

Separator : An ion permeable, electronically non-conductive, spacer or material which prevents electronic contact between electrodes of opposite polarity in the same cell/mono- block.

Series : The interconnection of cell/mono-blocks or batteries in such a manner that the positive terminal of the first is connected to the negative terminal of the second, & so on. Series connections increase the voltage of the resultant battery as follows :

$V_s = n \times V_u$ Where V_s is the resultant voltage, n is the number of cell/mono-blocks or batteries connected in series & V_u is voltage of the unconnected cell/mono-block or battery

Service Life : The period of useful life of a primary cell/mono-block or battery before a predetermined end-point voltage is reached.

Shelf Life : The duration of storage under specified conditions at the end of which a cell/mono- block or battery still retains the ability to give a specified performance.

Short Circuit Current : The initial value of the current obtained from a cell/mono-block or battery in a circuit of negligible resistance.

Specific Gravity : The specific gravity of a solution is the ratio of the weight of the solution to the weight of an equal volume of water at a specified temperature.

Standby Battery: A battery designed for emergency use in the event of a main power failure.

Starved Electrolyte Cell/mono-block : A cell/mono-block containing little or no free fluid electrolyte. This enables gases to reach electrode surfaces during charging and facilitates gas recombination.

State-of-Charge (SOC) : The available capacity in a cell/mono-block or battery expressed as a percentage of rated capacity.

Sulphation: Process occurring in lead batteries that have been stored & allowed to self-discharge for extended periods of time. Large crystals of lead sulphate grow that

interfere with function of the active materials.

Thermal Runaway : A condition whereby a cell/mono-block or battery on charge or discharge will overheat and destroy itself through internal heat generation caused by high overcharge or over discharging current or other abusive condition.

Trickle Charge : A charge at a low rate, balancing loses through a local action and/or periodic discharge, to maintain a cell/mono-block or battery in a fully charged condition.

Vent : A normally sealed mechanism which allows for the controlled escape of gases from within a cell/mono-block.

Vented Cell/mono-block : A cell/mono-block design incorporating a vent mechanism to relieve excessive pressure and expel gases that are generated during the operation of the cell/mono-block.

Voltage Delay : Time delay for a cell/mono-block or battery to deliver the required operating voltage after it is placed under load.

Voltage Efficiency : The ratio of average voltage during discharge to average voltage during recharge under specified conditions of charge and discharge.

Watt hour Capacity : The quantity of electrical energy measured in watt hours which may be delivered by a cell/mono-block or battery under specified conditions.

Watt hour Efficiency : The ratio of the watt hours delivered on discharge of a battery to the watt hours needed to restore it to its original state under specified conditions of charge and discharge. The percentage Wh efficiency is the product of Ah efficiency & the ratio of average discharge and recharge voltage.

Wet Shelf Life : The period of time that a cell/mono-block or battery can stand in the charged or activated condition before deteriorating below a specified capacity.

Working Voltage : The typical voltage or range of voltage of a cell/mono-block or battery during discharge.

~~END OF SECTION 8~~

APPENDIX-A

Guidelines for the purchaser/user

Guarantee: The manufacturer supplying the cells/mono-block/batteries as per this GR shall be responsible to replace/repair free of charge, the cell/mono-block/battery becoming faulty, owing to defective workmanship or material, within 18 months from the date of dispatch or 12 months from the date of commissioning of the cell/mono-block/battery into actual service whichever is earlier.

Packing: Packing shall be done in accordance with the latest guidelines issued by QA wing of BSNL under the supervision of QA staff.

Condition of Supply : To ensure the procurement of the correct type of cells/mono-blocks/batteries, the user shall furnish the following information regarding his requirements at the time of inquiry or order :

1. Application of the battery : Float/SPV
2. Number of identical batteries required in parallel
3. Number Cell per battery
4. The Rate of Charge and discharge at which the Mono-block/batteries are to work.
4. Capacity of the Mono-block/battery in Ampere Hours at C/10.
4. Type of stacking arrangement required depending on floor loading and space available: number of tiers/stack for battery.
4. Type of specific stand required if any.
4. Proposed location of Installation and Ultimate consignee
4. Probable date of commissioning of the mono-block/battery.
4. Accessories and spares required, if any
4. Any other special condition/requirement, if any

APPENDIX-B

The manufacturer shall furnish the following information:

1. Capacity of the Mono-block/battery at C/10 rate.
2. Manufacturers" name
2. Method of connections between the cells, whether Bolted or Burnt.
2. Type and Material of the container
2. Material of the separator.
2. Overall dimensions & weight of each complete cell
2. Space and floor loading in the desired configuration.
2. Specific order if any in which the cells are to be arranged.
2. Procedure for monitoring the health of mono-block/battery during maintenance and preventive measures required.
2. Measures required to be taken, at the site of installation . Showing the state of discharge and procedure for recoupment thereof .

The other terms and conditions of supply shall be subject to agreement between the two.

Discharge time calculations for the Service Life or Ageing test clause A-1/.6.4.4):

Discharge time will depend on the following factors:

a) **Duration of discharge:** The denominator of C as per column 1 of table given in clause 1.3.1.4

b) **Capacity ratio**: Actual capacity at 27 degree Celsius, observed as per capacity test (clause A- 1/6.3.1) and the rated capacity.

c) **Capacity Factor**: At the given rate of discharge under test (Clause 1.3.1.4)

d) **Temperature Factor**: Battery capacity at the temperature under test.

Discharge time = Duration of discharge X Capacity Ratio X Capacity factor X Temperature factor 1

The above calculations are being illustrated in the following examples:

Calculation:

a) **Duration of discharge:** Hours of discharge as per denominator of C at C/3 rate of discharge is 3 hours or 180 minutes A

b) **Capacity ratio:**
Cell/mono-block capacity (C10) at 27 Degree Celsius:
i) Rated say 100AH
ii) Actual observed during capacity test 110AH

Capacity ratio: Actual Capacity/Rated capacity 110/100 = 1.1 B

c) **Capacity Factor :** Expected capacity at the given rate of discharge (say C/3) as given in the table of clause 1.3.1.4
(Cell 71.7% and mono-block 75%) C

d) **Temperature Factor:** (Say Testing Chamber temperature 55 Degree Celsius)
Temperature factor shall be calculated by the following formula (taking AH capacity unity):

Temperature factor = $1_{27} + 1_{27}$(R X((t-27)/100 -- 2

The value of R (Temperature Correction factor) for any rate of discharge shall be as per the table given below:

Discharge Rate	C/10& above	C/9	C/8	C/7	C/6	C/5	C/4	C/3	C/2	C/1	C/0.
Value of R	0.43	0.45	0.47	0.50	0.54	0.58	0.62	0.68	0.76	0.90	0.95

Temperature factor at C/3 rate of discharge will be:

1 + 1(0.68 X (55-27)/100 = 1 + (0.68 X 28)/100 = 1.1904 D

Putting the values of A,B,C and D in formula

-1 Discharge Time is:

Duration of discharge X capacity factor X Temperature factor X Capacity Ratio

= 180 X 1.10 X 0.717 X 1.1904 = 169 minuteses

Abbreviations ~~Glossary~~

~~ABS Acrylonitrile-Butadiene-Styrene~~
~~AH Ampere Hour~~
~~ASTM American Society for Testing and Materials~~
~~A/T Acceptance Testing~~
~~BIS Bureu of Indian Standards~~
~~BSNL Bharat Sanchar Nigam Limited~~
~~C Capacity rating (Amp-hour) of the battery.~~
~~DOD Depth Of Discharge~~
~~ESD Electrostatic Discharge~~
~~GR Generic Requirement~~
~~IS Indian Standard~~
~~ISO International Standards Organisation~~
~~kPa Kilo Pascal~~
~~KV Kilo Volt~~
~~KVA Kilo Volt Ampere~~
~~mg/cm2 miligram per centimeter square~~
~~Mhz Mega Hertz~~
~~ml milli liter~~
~~mm milli meter~~
~~PP Polypropylene~~
~~ppm Part Per million~~
~~QA Quality Assurance~~
~~QM Quality Manual~~
~~sp. Gr Specific ravity~~

~~SPV Solar Photo Voltaic~~

~~T Tubular type~~

~~T&D Testing and Development~~

~~TAC Type Approval Certificate~~

~~UPS Uninterrupted Power Supply~~

~~V Volt~~

~~VRLA VALVE REGULATED LEAD ACID~~

ABS	Acrylonitrile-Butadiene-Styrene
AH	Ampere Hour
ASTM	American Society for Testing and Materials
A/T	Acceptance Testing
BIS	Bureau of Indian Standards
BSNL	Bharat Sanchar Nigam Limited
C	Capacity rating (Amp-hour) of the battery
DOD	Depth Of Discharge
ESD	Electrostatic Discharge
GR	Generic Requirement
IS	Indian Standard
ISO	International Standards Organisation
kPa	Kilo Pascal
KV	Kilo Volt
KVA	Kilo Volt Ampere
mg/cm²	Milligram per centimeter square
MHz	Mega Hertz

ml	Milliliter
mm	Millimeter
PP	Polypropylene
ppm	Parts Per Million
QA	Quality Assurance
QM	Quality Manual
sp. Gr	Specific Gravity
SPV	Solar Photo Voltaic
T	Tubular Type
T&D	Testing and Development
TAC	Type Approval Certificate
UPS	Uninterrupted Power Supply
V	Volt
VRLA	Valve Regulated Lead Acid

~~END OF DOCUMENT~~

Government of India

Department of Telecommunications Telecommunication Engineering Centre [FLA Division]

K. L. Bhawan, Janpath, New Delhi-110001

No. TEC/FLA/GR/BAT/VRLA/2010-11 Dated: 24/07/2012

Subject: Amendment in GR of Valve Regulated Lead Acid (VRLA) Batteries [GR No. TEC/GR/TX/BAT- 001/04.June.2011].

Amendment No.1

The following amendments have been made in the existing GR on VRLA Batteries [GR No. TEC/GR/TX/BAT- 001/04.June.2011]: -

Clause No. 1.2.1 of the main GR may be read as under: -

Float and Cyclic Application: *The batteries in Indian Telecom Network are used for Float and cyclic application depending upon the requirement and location. The battery may be required to provide*

~~*a back-up between 6 to 72 hours.*~~

~~***Float Application:** The battery is normally not allowed to discharge beyond 80% of C (rated capacity of the battery at C/10 rate of discharge). Number of discharge cycles up to 80% DOD, per year may be up to four to five in metropolitan areas and more in the semi-urban & rural areas depending the commercial mains supply conditions. `C', wherever used in this document, stands for the capacity of the cell/mono-block/battery at **C/10** rate of discharge. These type of batteries are charged normally at **C/3.33** rate in a constant voltage charge mode. The battery may be charged at higher rate if recommended by the manufacturer.*~~

~~***Cyclic Application:** The battery is normally not allowed to discharge beyond 60% of C (rated capacity of the battery at C/10 rate of discharge). `C', wherever used in this document, stands for the capacity of the cell/mono-block/battery at **C/10** rate of discharge. These type of batteries are charged normally at **C/3.33** rate in a constant voltage charge mode. The battery may be charged at higher rate if recommended by the manufacturer.*~~

~~Clause No. 3.5 of the main GR may be read as under: -~~

~~***Pressure Regulation Valve:** Each cell shall be provided with a pressure regulation valve. The valve shall be self re-sealable and flame retardant. The Valve unit shall be such that it cannot be opened without a proper tool. The valve shall be capable to withstand the internal cell pressure of C/5 rate of charge and C/3 rate of discharge or higher, as specified by the manufacturer for the purpose but it shall not be less than 3 psi and resealing above atmospheric pressure in any condition of operation*~~

~~*i.e. charging/discharging. In case the mono-blocks design has used a common pressure regulating valve, it shall also comply the requirement of clause 6.2 & 6.3 pertaining to Oxygen recombination & cell/mono-block pressure in addition to the above. For test procedure refer clause 7.6.1.3.3 of the GR.*~~

~~Clause No. 3.7 of the main GR may be read as under: -~~

~~***Connectors:*** *Where it is not possible to bolt the cell terminals directly to assemble a battery, separate non corroding lead or copper connectors of suitable size shall be provided to enable connection of the cells. Copper connectors shall be suitably lead coated to withstand corrosion due to sulphuric acid at a very high rate of charge or discharge. The thickness of the lead coating of connectors shall not be less than 0.025 mm when measured in accordance with Appendix F of IS: 6848 - 1979. The area of cross-section of the connectors shall be sufficient to meet the requirement of the rate of charge/discharge as per tender requirement & shall be rated at 2 amp/mm square (minimum). For test purpose it shall be C/3 rate of discharge. No flexible cable is permitted for series parallel connections. All the basic cells shall be supplied to meet the requirement for C/3.33 rate of charging.*~~

~~Clause No. 5.11.3 of the main GR may be read as under: -~~

~~***Conductance Matching:*** *Conductance of each cell/ cell module in the battery, when connected in series, shall be within +/-15%of the average cell/cell module conductance. Also, when the cells are connected in parallel to form a cell module, the conductance of all the cell in the cell module shall be within +/- 15% of the average conductance of the cells of the module.*~~

~~Clause No. 6.7 of the main GR may be read as under: -~~

~~***Positive Plate Growth:*** *It shall be less than 8% of the total plate area throughout the specified life. For test procedure refer clause 7.6.4.4 of the GR. The cell design should be such that it should allow positive plate growth as per clause 3.6.*~~

~~Clause No. 7.5.3 (9) of the main GR may be read as under: -~~

~~*9.*~~		~~*Type Test*~~	~~*Bulk Acceptance Test by QA*~~	~~*Acceptance Test at Site by T&D*~~

Cell/mono-block Matching	*No*	*Yes* *(as per QA procedure)*	*Yes*
Voltage/Capacity Matching	*No*	*- do -*	*Yes*
Conductance Matching	*Yes*	*No*	*No*

Clause No. 7.6.4.4 of the main GR may be read as under: -

The following bullet of the clause may be shifted from Part-II to Part-I after modification as below: -

The cell/mono-block shall be discharged at a rate equal to 0.333 x C for the time calculated as per Appendix C.

Rest of the clause has no change.

------ End of Amendment.1 ------

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(Mrs. Laxmi)