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

File No.: **33-7/2026-FA/TEC** **Dated: 19.08.2026**

Subject: Invitation for Manufacturer's Forum (MF) meeting of Fixed Access division of TEC -Reg

An online meeting of Manufacturer's Forum of the division is scheduled on Tuesday, **25th August 2026 at 03:00 PM** to discuss on the draft New Test Guide against the standard for GR on **VALVE REGULATED LEAD ACID (VRLA) BATTERIES (TEC 67010:2026).**

Online Meeting link: https://cdotmeet.cdot.in/vmeet/rooms/eb2-qro-wgi-tsc/join

2. The soft copy of the pre-MF draft Test Guide of VALVE REGULATED LEAD ACID (VRLA) BATTERIES (TEC 67010:2026). is enclosed for inputs/comments.

3. Members of MF are requested to kindly provide their inputs/ comments as per the format attached as Annexure -A by **24th August 2026** at email id adgfa-tec-dot@gov.in with copy to rafa.tec-dot@govcontractor.nic.in; dirfa.tec@gov.in and ddgfla.tec@gov.in.

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

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

Encl: As mentioned above

To ,
1. All Manufacturer Forum Members.
2. AD (IT), TEC for uploading on TEC web site.

ANNEXURE-A

NAME OF …….
(MEMBER of MANUFACTURER FORUM)

2. Comments on the draft Test Guide (TEC 67011:2026) for GR on "VALVE REGULATED LEAD ACID (VRLA) BATTERIES (TEC 67010:2026)":

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

परीक्षण निर्दे शका

टीईसी ६७०११:२०२६

TEST GUIDE

TEC 67011:2026

For

वाल्व रेगुलेटेड लेड ए सड (वीआरएलए) बैटरीस

(मानक संख्या.: टीईसी ६६१७०:२०२५)

VALVE REGULATED LEAD ACID (VRLA) BATTERIES

(STANDARD No.: TEC 67010:2026)

ISO 9001:2015

दूरसंचार अ भयांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली-110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

www.tec.gov.in

Release 1: XXXX, 2026

FOREWORD

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

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- 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 enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Valve Regulated Lead Acid (VRLA) Batteries as per GR No. TEC 67010:2026.

CONTENTS

A. HISTORY SHEET

S. No.	*Standard/ Document No*	*Title*	*Remarks*
1.	TEC 67010:2026	VALVE REGULATED LEAD ACID (VRLA) BATTERIES	First issue

B. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Valve Regulated Lead Acid (VRLA) Batteries as per GR No. TEC 67010:2026.

C. General information

Sl. No.	General Information	Details *(to be filled by testing team)*	
1.	Name and Address of Applicant		
2.	Date Of registration:		
3.	Name and No. of GR/IR/Applicant's Spec. against which type approval sought	Valve Regulated Lead Acid (VRLA) Batteries	TEC 67010:2026.
4.	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5.	Any other relevant Information:-		

:

D. Testing team: (*to be filled by testing team*)

S. No.	Name	Designation	Organization	Signature
1.				
2.				
3.				

E. List of the test instruments:

S. No.	Name of test Instrument	Quantity	Make / Model *(to be filled by testing team)*	Validity of calibration (to be filled by testing team) dd/mm/yyyy	Remark
1.					
2.					
3.					
4.					

F.Equipment Configuration Offered: *(to be filled by testing team)*

(a) <Equipment/product name> Configuration:

Sl. No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product.

(b) <Other equipment name> Configuration:

Sl. No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product.

G. Equipment System Manuals: (*to be filled by testing team)*

Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc. (Y/N)

H. Clause-wise Test Type and Test No.:

Clause. No.	*Clause*	*Type of Test / Test No. etc.*
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.	Information
1.2	The batteries as per this GR are used, mainly for two applications as follows:	Information
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 6 to 72 hours. **i) 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) to avoid deep 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 types 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. **ii) Cyclic Application**: The battery is normally not allowed to discharge	Undertaking along with the requisite information from OEMs / Manufacturers

	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 types 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.	Undertaking from OEMs / Manufacturers
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/20 rate 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.	Physical Check
1.2.2.1	The Batteries for 12V SPV equipment/systems 12V mono-blocks or six 2V cells (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 equipment working on voltage higher than 12V only 2V cells are to be connected in series to achieve the desired voltage.	Physical Check

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.	Undertaking along with the requisite information from OEMs / Manufacturers
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.	Physical Check
2.2	**Designation:** The cell/mono-block shall be designated by symbols as given in clauses 2.2.1 to 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.	Physical Check
2.2.1	**Voltage of the cell/mono-block:** 2V for cell and 12V for mono-block.	Physical Check
2.2.2	**Type of +ve Plate**: The positive plates shall be designated as: Flat Pasted type : F Tubular type : T	Physical Check
2.2.3	**Capacity:** The capacity shall be indicated by a number equal to the capacity in AH.	Information
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	Information

	of Polypropylene Material.	
2.3	**Marking**: The following information shall be indelibly & durably marked. 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 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. **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.	Physical Check
2.4	**Installation & Maintenance Manual**: Two copies of the Installation & Maintenance Manual in English hard copy, Soft copy (URL link /QR	Required documents

	code) of Documentation may also be supplied both in English and Hindi. along with each unit/set. The manual shall include :	to be provided by OEM
2.5	• 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 Guidelines 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 cycle life will be clearly declared by the battery manufacturers.	Required documents to be provided by OEM and Physical Check
2.5.1	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	Information

	so as to make it presentable. Soft copy of the Installation and Maintenance Manual may preferably be provided in the form of QR Code/ pdf file.	
2.6	**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	Required documents to be provided by OEM and Physical Check
2.7	**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 as decided by the purchaser. If Field trial is carried out for higher capacity battery bank then the field trial will not be required for lower capacity battery bank, if same cell plate is being used in the lower capacity battery bank. Same will apply for parallel models also.	Information
2.8	The shelf life of the cell/mono-block/battery shall comply with the requirements of the clause 5.7.	Information
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.	Undertaking from OEM/Manufacturer
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 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. **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"	Undertaking from OEM/ Manufacturer
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 compliant to safety standard (i.e. TEST FOR RESISTANCE TO ACID) as per Appendix-E of IS 1146:1981(or latest one).	The certificate and test results from any authorized Lab as per

		extant instructions from MTCTE division of TEC.
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%.	Undertaking from OEM/Manufacturer
3.2.3	The container shall be symmetrical in shape & stand level on the plane level surface.	Undertaking from OEM/Manufacturer
3.2.4	The internal area of the container shall have sufficient provision for growth of the +ve plate.	Undertaking from OEM/ Manufacturer
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.	Undertaking from OEM/ Manufacturer
3.2.6	The tensile strength of the material of the container be such as to handle the internal 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.	The certificate and test results from any authorized Lab as per extant instructions

		from MTCTE division of TEC.
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).	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
3.4	Separators: The separators used shall be of glass mat having high acid absorption capability, resistant to sulphuric acid and good	The certificate

	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 standard TEC 14016:2010 (old no. QM-333 Issue March 2010). For test procedure refer clause 7.6.1.3.2 of the GR.	and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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.	Test Case-1
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	Test Case-5

	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.	Physical Check
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. Since charging current is C/3.33 rate whereas discharging current is C/6 or slower rate. Therefore the connectors of the Battery banks should withstand the charging currents.	Physical Check
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.	Test case-15
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.	Physical Check
3.9.1	The material of the flame arrestor shall not affect the performance of the cell/mono- block.	Underatking from OEM/ Manufactur er
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.	Information
4.2	**Quality Requirements:**	
4.2.1	VRLA Batteries shall be manufactured in accordance with the International Quality Standard ISO 9001:2015 (or latest version) for which the manufacturer shall be duly accredited.	Underatking from OEM/ Manufacturer
4.2.2	**Quality of material &Workmanship**: All the material &workmanship shall be of professional grade and highest quality.	Undertaking from OEM / Manufacturer
4.2.3	**Quality Assurance Tests:** Mono-blocks/Batteries supplied against specific order after valid certification like Type Approval shall be inspected and tested to ensure that the requirements of this document have been met.	Information
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"	Undertaking from OEM / Test Certificate
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.	Undertaking from OEM
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.	Information
4.2.4.4	The battery manufacturer shall also comply the environmental requirements in accordance with ISO 14001:2026(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.	The certificate and test results from

		any authorized Lab as per extant instructions from MTCTE division of TEC.
4.2.4.5	The battery manufacturer shall also comply the occupational health and safety (OH&S) requirements in accordance with ISO 45001 (Latest issue) for which he shall be duly certified.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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 TEC 14016:2010 (old no. QM-333 Issue March 2010) category B2 shall be capable to work satisfactorily at an altitude specified in clause 14.4 of TEC 14016:2010 (old no. QM-333 Issue March 2010) & saline atmosphere of coastal area in compliance of clause 11 of TEC 14016:2010 (old no. QM-333 Issue March 2010) respectively. It shall be capable to withstand the rigours of transportation in compliance of clause12 & 13 of TEC 14016:2010 (old	The certificate and test results from any authorized Lab as per

	no. QM-333 Issue March 2010).	extant instructions from MTCTE division of TEC.
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.	Information
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.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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. It shall be tested in accordance with IEC61000-4-2.	The certificate and test results from any authorized Lab as per extant instructions

<table>
<tr><td></td><td></td><td>from MTCTE division of TEC.</td></tr>
<tr><td>4.4</td><td>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 7.6.2.3.4 of the GR.</td><td>Test Case-2</td></tr>
<tr><td>5.0</td><td>Electrical Requirements</td><td></td></tr>
<tr><td>5.1</td><td>Capacity:</td><td></td></tr>
<tr><td>5.1.1</td><td>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 than 120% of C(rated capacity) when discharged to the cell voltage of 1.75V.</td><td>Test Case-3</td></tr>
<tr><td>5.1.2</td><td>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.</td><td>Test Case-3</td></tr>
<tr><td>5.1.3</td><td>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.</td><td>Test Case-3</td></tr>
<tr><td>5.1.4</td><td>The capacity of the cell/mono-block/battery at discharge rates C/3 to C/120shall be as given below:
<table>
<tr><th rowspan="2">Rate of</th><th colspan="3">Cell</th><th colspan="3">Mono-Block</th></tr>
<tr><th>Discharge</th><th>Capacity expressed as % of C/10</th><th>End cell</th><th>Discharge</th><th>Capacity expressed as % of C/10 Discharge rate</th><th>End cell</th></tr>
</table></td><td>Test Case-3</td></tr>
</table>

	Discharge	**Current**	**Discharge rate**	**voltage**	**Current**		**voltage**
	C/3	0.333C	71.7	1.74V	0.333C	75.0	10.44V
	C/4	0.25C	78.2	1.74V	0.25C	81.0	10.44V
	C/5	0.2C	83.3	1.75V	0.2C	85.0	10.5V
	C/6	0.167C	87.3	1.75V	0.167C	91.0	10.5V
	C/8	0.125C	95.0	1.75V	0.125C	95.0	10.5V
	C/10	0.1C	100 to 120	1.75V	0.1C	100 to 120	10.5V
	C/20	0.05C	120.0	1.75V	0.05C	120.0	10.5V
	C/72	0.014C	130.0	1.75V	0.014C	130.0	10.5V
	C/120	0.0083C	150.0 **(SPV Application only)**	1.75V	0.0083C	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.						Test Case-4
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.						Test Case-4
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.						Test Case-4
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.						Test Case-13
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:						Physical Check
	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/8, C/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.			Undertaking from OEM / Manufacturer
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.			Test Case-6
5.7	**Loss of Capacity during Storage**:			
5.7.1	The loss in capacity during storage at an average ambient temperature of 35 deg C 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.			Test Case-7
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.			Test Case-7
5.8	**Ampere Hour (Ah) Efficiency**: Shall be better than 90%.For test procedure refer clause 7.6.3.7 of the GR.			Test Case-8

5.9	**Watt-Hour Efficiency**: Shall not be less than 80%. For test procedure refer clause 7.6.3.8 of the GR.	Test Case-8
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. For test procedure refer clause 7.6.3.9 of the GR.	Test Case-5
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.	Test Case - 10
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.	Test Case-14
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.	Test case-14
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.	Test case-14
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.	Test Case-14
5.11.2.2	**Series Capacity Matching**: The difference between the highest and	Test Case-

	lowest cell capacities in a cell module & cell modules in a battery string shall not be more than 8% of their rated capacity.	14
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.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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.	Test Case-10
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.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE

		division of TEC.
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.	Test Case-9
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.	Test Case-1
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.	Test Case-12
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.	Test Case-10
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.	Test Case-10
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.	Test Case-10
6.8	**Thermal Run-away :** While operating in the normal operating conditions the cell/mono-block or battery shall not lead to dry out,	Test Case-11

	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.	
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.	Information
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.	Information
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:	Physical Check
7.2.2.1	**Bulk Acceptance Tests:** These tests are carried out by the purchaser, as per requirement to ensure that the each cell/mono-block/battery is in the compliance of the GR. The sampling scheme and criteria for acceptance shall be in accordance with IS 8320 : 2000 (or latest) (at least two samples per production batch).	Physical Check
7.2.2.2	**Acceptance tests at Site**: This testing is not mandatory. This depends on the purchaser.	Physical Check
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:	Physical Check
7.3.1	**Test Instruments**:	Undertakin

			g from OEM/ Certificate

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 or Data Logger	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**		Information

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 deg Celsius +/- 3 deg Celsius, 75 deg Celsius+/- 3 deg Celsius & 35 deg Celsius + 3 deg Celsius.
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 deg Celsius or in compliance with the	Information

<table>
<tr><td></td><td>clause.</td><td></td></tr>
<tr><td>7.4</td><td>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.</td><td>Information</td></tr>
<tr><td>7.4.1</td><td>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.</td><td>Test case-7</td></tr>
<tr><td>7.5</td><td>Testing of cell/mono-block/batteries: The test to be conducted are as summarized below:</td><td>Information</td></tr>
<tr><td>7.5.1</td><td>Physical and Constructional verification:

<table>
<tr><th>S. No.</th><th>Test</th><th>Type Test</th><th>Bulk Acceptance Test</th><th>Acceptance Test At Site</th></tr>
<tr><td>1.</td><td>Design Practices</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>2.</td><td>Marking</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td>3.</td><td>Packing</td><td>No</td><td>Yes</td><td>No</td></tr>
<tr><td>4.</td><td>Verification of Dimensions</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
<tr><td>5.</td><td>Stacking</td><td>Yes</td><td>Yes</td><td>Yes</td></tr>
</table></td><td>Information</td></tr>
</table>

	Arrangement				
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:** Information

S. No.	Test	Type Test	Bulk Acceptance Test	Acceptance Test At Site
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:** Information

S. No.	Test	Type Test	Bulk Acceptance Test	Acceptance Test at Site
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: Voltage/capaci	No No No	Yes - do - Yes	Yes Yes No

	ty Matching: Conductance Matching:				
	10.	Battery Reliability	No	Yes	No

7.5.4	**Chemical Tests** **S. No.** / **Test** / **Type Test** / **Bulk Acceptance Test** / **Acceptance Test At Site** 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 Cycle — Yes / No / No 5(a) Grid Corrosion — Yes / No / No 5(b) Positive Plate Growth — Yes / No / No	Information
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.	Information
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 5.11 and also as certain the actual loss of capacity during the period of storage.	Information
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.	Information
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 &	Information

<table>
<tr><td></td><td>Acceptance tests shall be conducted in the stacking arrangement as per purchase order.</td><td></td></tr>
<tr><td>7.6.1.3</td><td>Tests for Materials: Test for materials of construction shall be carried out as below:</td><td>Information</td></tr>
<tr><td>7.6.1.3.1</td><td>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:
<table>
<tr><th>Sr. No.</th><th>Name of test</th><th>Test method (Spec. ref.)</th><th>Requirement</th></tr>
<tr><td>1.</td><td>Plastic yield</td><td>IS: 1146:1981 (appendix-D)</td><td>Not > 5 mm</td></tr>
<tr><td>2.</td><td>Acid Resistivity</td><td>IS:1146:1981</td><td>Change in mass shall not be > 2mg/ cm^2 for 10cmX6.5cm</td></tr>
<tr><td>3.</td><td>Impurities of Unpainted surface
a) Iron
b)Chlorine
c) Manganese</td><td>IS:1146:1981</td><td>Not > 0.16 mg/cm^2
Not > 0.08 mg/cm^2
Not > 0.0016 mg/cm^2</td></tr>
<tr><td>4.</td><td>Density</td><td>ASTM D-792-1986</td><td>Shall comply the requirement of the standard for the material.</td></tr>
<tr><td>5.</td><td>Tensile Strength</td><td>ASTM D-638-1989</td><td>220 kg/cm^2 minimum</td></tr>
<tr><td>6.</td><td>Flexurol Modulus</td><td>ASTM D-790-1986</td><td>8000 kg/cm^2 minimum</td></tr>
<tr><td>7.</td><td>Izod impact Strength</td><td>ASTM D - 256 -1988</td><td>Shall comply the requirement of the standard for the material.</td></tr>
<tr><td>8.</td><td>Melt flow Rate</td><td>ASTM D - 1238-1988</td><td>Shall comply the requirement of the standard for the material.</td></tr>
<tr><td>9.</td><td>Heat distortion</td><td>ASTM D - 648- 1988</td><td>Test condition : Pressure: 455 KPa (66 psi)</td></tr>
</table>
</td><td>The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.</td></tr>
</table>

			Limit : 85 °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 7.6.2.3.2.
- 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 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:**	The certificate

	• Wicking: The total wicking height in separator shall not be less than 630mm in 24 hours. • The uncompressed water absorption of the separator shall be • 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.	and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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.	Test Case - 1
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.	Test Case - 5
7.6.1.3.5	**Connectors**: • The connectors shall be in compliance with the requirements of	Information

	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).	Test case-15
7.6.2	**Quality Requirements**:	
7.6.2.1	**Manufacturing of batteries as per ISO 9001:2015** It shall be verified and ensured that the VRLA Batteries are manufactured in accordance with the International Quality Standard ISO 9001:2015(or latest version) for which the manufacturer has been duly accredited.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
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 conducting all the tests listed for Bulk acceptance tests.	Information

7.6.2.3.1	**Operational Requirements:**	
7.6.2.3.1	**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 TEC 14016:2010 (old no. QM-333 Issue March 2010) Category B2 including Vibration tests as per TEC 14016:2010 (old no. QM-333 Issue March 2010).	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
7.6.2.3.2	**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.	The certificate and test results from any authorized Lab as per extant instructions from MTCTE division of TEC.
7.6.2.3.3	**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.	The certificate and test results

		from any authorized Lab as per extant instructions from MTCTE division of TEC.
7.6.2.3.4	**Battery Reliability**: These tests shall be conducted 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.	Test Case-2
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	Test Case-3

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 at 27° 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 within 5 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/72 and C/120 shall be performed and in all these tests the capacity shall comply the	Information

	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 7.6.3.1 above 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)	Test Case-4

	• 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.	Test Case-13
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.	Information
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.	Test Case-6
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**	Test Case-7

	• 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 • 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 manufacturer 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 manufacturer 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.	Test case-8

	• 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%.	Test case-8
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	Test case-5
7.6.3.10	**Cell Matching:** **A. Parallel Cell matching (to be conducted by TEC at the time of Type Testing)** • 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.	Test case-14

B. Series matching (to be conducted 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)

- 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 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	Test Case-9

	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 deg Celsius per AH of electricity discharge (ml/AH) 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 deg Celsius.	
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.	Test Case - 1
7.6.4.3	Gassing:	Test Case -

	• 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.	12
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/3 for 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 B. **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.	Test case-10

	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.	Test Case-11
8.0	**Safety Requirements:** The equipment shall conform to relevant safety requirements as per Secondary Batteries and Battery Installations category of equipment	Certificates from accredited

	as prescribed under Table no. 1 of the TEC document 'SAFETY REQUIREMENTS OF TELECOMMUNICATION EQUIPMENT": TEC10009: 2024(or latest)'.	test labs are to be submitted
9.0	**Environment Requirements:** 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 Issue March 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.	Certificates from accredited test labs are to be submitted

I. TEST SETUP & PROCEDURES:

Note:

(a) The test set-up given in this document are tentative and may be changed by testing officer, considering, network/testers/ analyzer/simulator availability. In case of any discrepancy between this Test Guide and GR, GR clause shall prevail.

(b) Since this is provisional Test Guide. Based on inputs received setup was prepared. Whenever the first testing was offered this provisional Test Guide would be revised.

(c) Actual setup and tester/simulator may vary at the time of testing.

(d) Testing of Valve Regulated Lead Acid (VRLA) Batteries will be done on the basis on testing facility available for testing Valve Regulated Lead Acid (VRLA) Batteries. If no testing facility is available for testing Valve Regulated Lead Acid (VRLA) Batteries, then undertaking from OEM may be taken.

Test No.	**Test Case-1 (Regulating Valve & Cell Pressure Test)**
Test Details	Clause no. 3.5, 6.3, 7.6.1.3.3, and 7.6.4.2
Test Setup	1. Five (5) regulating valves selected for testing 2. Fully formed cell / mono-block assembly 3. Controlled DC power supply (capable of C/5 rate) 4. Safety Valve Test Jig & Calibrated Pressure Gauge 5. Temperature chamber calibrated to 35°C ambient temperature
Test Procedure	1. **Valve Functioning & Leak Test Sequence :** a) Visually inspect all 5 selected regulating valves for surface defects. b) Mount each valve onto the test jig using proper sealing compound to prevent auxiliary leaks, then gradually increase internal pneumatic pressure to record the exact opening pressure and lower it to record the resealing pressure and repeat this cycle for 5 consecutive iterations and record all values. 2. **Pressure Release & Resealing Verification Sequence :** a) Mount the verified valve onto the cell/mono-block and connect the cell to the charging power supply. b) Then, subject the cell to charging at C/5 rate and discharging at C/3 rate to build internal pressure and monitor that the valve doesnot vent below 3 psi. c) Observe the pressure release action upon reaching the upper threshold and allow the valve to reseal automatically and record the internal pressure point at resealing then cross-verify that the resealing pressure value remains higher than the minimum pressure required to achieve 99% gas recombination. 3. **Cell Over-Pressure Integrity Sequence :** a) Remove the pressure regulating valve from a fully formed cell/mono-block and fit a calibrated pressure gauge and

	pneumatic pressure inlet to the valve port. b) Increase the internal pressure to 3 times the maximum operating pressure of the regulating valve and seal the inlet valve maintaining the pressure for 24 hours and record initial and final pressure. c) Also, inspect the container walls, cover, and seams for any signs of pressure drop, gas leakage, bulging, cracking, or permanent mechanical deformity. 4. **Gas Recombination Pressure Verification Sequence :** a) Place the cell/mono-block inside the environmental temperature chamber stabilized at 35°C. b) Charge the cell at a constant C/5 (0.2C) rate while continuously monitoring the internal pressure using a calibrated pressure transducer or data logger. c) Record the steady-state, venting, and resealing pressures, and verify that the operating pressure is not less than 3 psi and is sufficient to achieve 99% gas recombination at 35°C.
Test limits	1. Ensure that internal cell/mono-block pressure shall be sufficient for 99% gas recombination at 35°C and shall not be less than 3 psi in any working condition. 2. Valve resealing shall take place before the internal pressure drops to the value necessary for 99% gas recombination. 3. Venting shall occur exclusively through the regulating valves. 4. Under 3x operating pressure held for 24 hours, there shall be no change in pressure, no gas leakage, and no deformity/cracks/bulging in the cell/mono-block container or cover.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-2 (Battery / Mono-Block Reliability Test)**
Test Details	Clause no. 4.4 and 7.6.2.3.4
Test Setup	1. Fully charged battery bank or mono-block. 2. Variable resistive load bank capable of C/10 rate discharge. 3. Calibrated DC voltmeter and current meter. 4. Data logger or storage oscilloscope for continuous voltage monitoring
Test Procedure	1. Ensure the battery bank or mono-block is fully charged as per manufacturer guidelines. 2. Simulate a cell failure condition: i. For Battery: Simulate a cell failure condition by safely bypassing two (2) cells in a 24-cell string (reducing total active cells to 22 cells), or one (1) cell in a 12-cell string (reducing total active cells to 11 cells). ii. For Mono-Block: Simulate a single cell failure condition by bypassing one (1) cell in the mono-block. 3. Connect the modified battery string/mono-block to the resistive load bank and initiate a discharge test at the C/10 rate. 4. Continuously log the total battery voltage and individual cell voltages at regular intervals up to 6 hours and verify string voltage levels at the 4-hour and 6-hour marks against specified thresholds.
Test limits	1. Battery Bank (22 cells / 11 cells active): • Voltage at the end of 4 hours shall be higher than 44.4V (for 22-cell string) or 22.2V (for 11-cell string). • Voltage at the end of 6 hours shall be higher than 42.3V (for 22-cell string) or 21.1V (for 11-cell string). • No individual active cell voltage shall drop below 1.92V at the 6-hour mark.

	2. Mono-Block (5 cells active): • Voltage at the end of 4 hours shall be higher than 10.1V. • Voltage at the end of 6 hours shall be higher than 9.6V.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-3 (Capacity Test)**
Test Details	Clause no. 5.1.1, 5.1.2, 5.1.3, 5.1.4 and 7.6.3.1
Test Setup	1. Fully charged cell / mono-block / battery bank 2. Variable resistive load bank capable of maintaining discharge current within ±1% accuracy. 3. Calibrated DC voltmeter, current meter, and timer. 4. Temperature measuring device for terminal temperature recording. 5. Data logger / storage oscilloscope for continuous voltage logging.
Test Procedure	1. Allow the fully charged cell/mono-block/battery to stand on open circuit for 12 to 24 hours. 2. Connect to the variable resistive load and initiate discharge at a constant current of I = C/10 amperes, maintaining current within 1% of the specified rate. Measure and log voltage and current: i. every 5 minutes for the first 15 minutes ii. hourly for the next 8 hours iii. every 15 minutes thereafter until reaching the end voltage 3. Record terminal temperatures at regular intervals to determine the average electrolyte temperature. 4. Stop discharge when the closed circuit voltage reaches the cutoff limit: 1.75V/cell, 10.5V/mono-block, or 1.75V for any cell in a battery string. 5. Apply temperature correction formula to convert observed capacity to capacity at 27°C and repeat charge/discharge cycles if needed until 100% rated capacity is achieved and stabilized across the consecutive cycles.

Test limits	1. Capacity at 1.85V/cell shall not be less than 80% of rated capacity. 2. Final Corrected Capacity (at 27°C) shall achieve 100% of rated capacity within 5 cycles. 3. Discharge Current Tolerance shall be maintained within ±1% of specified discharge rate.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-4 (Charging & Sulphation Tests)**
Test Details	Clause no. 5.2.1, 5.2.2, 5.2.3, and 7.6.3.2
Test Setup	1. Fully formed cell, mono-block, or battery bank installed in a horizontal or vertical f orientation as per the manufacturer design. 2. Controlled DC power supply with constant-voltage regulation 3. Variable resistive load bank. 4. Calibrated DC ammeter, voltmeter, timer, and surface temperature logging system.
Test Procedure	**1. Float Recharge from Fully Discharged State:** a) Discharge the cell/mono-block to 1.60V/cell (9.6V/mono-block), or until any individual cell in a battery string reaches 1.60V. b) Switch to charging mode at 2.25V/cell (13.5V/mono-block) for 72 hours, or until the charging current stays within 5% variation for at least 2 consecutive hours. c) Discharge the unit at a C/10 rate and measure delivered ampere-hours to confirm full 100% capacity recovery. **2. High-Voltage Overcharge Stability Test:** a) Charge the cell/battery at a constant voltage of 2.45V/cell (14.7V/mono-block) for 72 hours, or until the charging current stabilizes completely. b) Continuously monitor surface temperature to ensure stabilization occurs within the first 4 hours, and inspect for physical degradation or deformation. **3. Sulphation Immunity & Slow Discharge Test:** a) Discharge the unit at a C/80 rate continuously for 24 hours and disconnect load and leave the unit on open-circuit for 120 hours (5 days) without disturbance. b) Recharge at a C/20 rate for 4 hours, followed immediately by

	a C/80 rate for 12 hours. c) Discharge at a C/120 rate down to a cut-off voltage of 1.90V/cell (11.4V/mono-block) and record total elapsed discharge time.
Test limits	1. Ensure that the cell, mono-block, or battery recharges from a fully exhausted state (1.60V/cell or 9.6V/mono-block) at specified float voltage, and recovers 100% of its rated capacity. 2. Ensure that the cell, mono-block, or battery permits charging at 2.45V/cell (14.7V/mono-block) in constant voltage mode, with surface temperature stabilizing within the first 4 hours and zero cell damage or bulging. 3. Ensure that slow charging and discharging at C/72 or C/120 rates does not affect performance or lead to sulphation, and that the C/120 discharge duration lasts at least 108 hours before reaching the 1.90V/cell (11.4V/mono-block) threshold.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-5 (Terminal Post & Short Circuit Test)**
Test Details	Clause no. 3.6, 5.10, 7.6.1.3.4, and 7.6.3.9
Test Setup	1. Fully charged cell or mono-block. 2. Short Circuit Test Jig equipped with low-resistance copper switching contacts compliant with BS 6290. 3. Calibrated DC voltmeter, ammeter, and high-speed data logger / storage oscilloscope. 4. Thermal imaging camera or surface temperature sensors for terminal post temperature monitoring.
Test Procedure	1. Visually inspect both positive (+) and negative (-) terminal posts to ensure clear, unambiguous polarity markings and proper acid-resistant, corrosion-retarding coating. 2. Connect the fully charged cell/mono-block to the BS 6290 Short Circuit Test Jig and apply a direct external short circuit across the terminals until the terminal voltage drops completely to zero. 3. Record peak short-circuit current, voltage decay profile, and temperature rise at the terminal posts throughout the short circuit duration. 4. Inspect terminal posts, and cover sealing immediately following the test. Verify that terminal post seals withstand the short-circuit heat without melting, deforming, leaking electrolyte, or igniting.
Test limits	1. Ensure that no fire or explosion is caused by applying an external short circuit until terminal voltage reaches zero. 2. Terminal post seals shall neither melt nor deform under the extreme thermal load generated during short circuiting. 3. Positive and negative terminals must be unambiguously marked and coated with an acid-resistant, corrosion-retarding alloy.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-6 (Transient Response / Coup De Fouet Test)
Test Details	Clause no. 5.6 and 7.6.3.5
Test Setup	1. Fully charged cell, mono-block, or battery bank. 2. DC charging power supply operating in float mode 3. Variable resistive load bank. 4. Fast-sampling storage oscilloscope or high-speed data logger connected across battery terminals.
Test Procedure	1. Charge the cell, mono-block, or battery bank completely in accordance with the manufacturer's specified charging guidelines. 2. Connect the battery to the charger operating in float mode in parallel with a resistive load equal to the C/3 discharge rate. Disconnect the AC mains input to the charger so that the discharge load is instantly transferred to the cell/mono-block/battery. 3. Trigger the fast-sampling storage oscilloscope or data logger at the exact moment of power supply interruption and continuously record the voltage dip profile across the cell/mono-block/battery terminals throughout the first 10 minutes of discharge.
Test limits	1. Voltage of any individual cell in the battery string shall not dip below 1.89V during the first 10 minutes following load transfer. 2. Closed-circuit voltage of a mono-block shall not fall below 11.34V during the first 10 minutes following load transfer. 3. Voltage dip limits must be maintained under load transfer conditions throughout the operational life of the battery.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-7 (Loss of Capacity During Storage)**
Test Details	Clause no. 5.7.1, 5.7.2, 7.4.1 and 7.6.3.6
Test Setup	1. Two separate fully formed cells or mono-blocks that have successfully passed the initial capacity test. 2. Temperature-regulated chamber calibrated and maintained at 35 deg celsius. 3. Variable resistive load bank for C/10 capacity discharge testing. 4. Calibrated DC voltmeter, ammeter, and timer.
Test Procedure	1. Verify and record the initial capacity (C) of the selected cell, mono-block, or battery. The cell/mono-blocks shall be fully recharged as per manufacturer's instructions. 2. Then clean and wipe all exterior surfaces completely dry before placing the unit on open circuit for storage for a period of 6 months without disturbance in chamber maintained at a temperature of 35 deg. Celsius. 3. After 6 months, remove the units from the chamber and discharge them at C/10 rate and record the post-storage capacity as C_1 and calculate percentage capacity loss: $S = ((C - C_1)/C) \times 100$. 4. Recharge the units again per manufacturer instructions and perform the capacity test at C/10 rate of discharge for three cycles and confirm that capacity shall be more than 85% of C within the first 3 cycles and achieves 100% rated capacity (C) within 5 cycles.
Test limits	1. Capacity loss (S) after 6 months at 35°C open-circuit storage shall not exceed 50%. 2. The unit shall have capacity more than 85% of rated capacity within 3 cycles, and achieve 100% rated capacity within 5 cycles after storage.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-8 (Ampere-Hour & Watt-Hour Efficiency Test)**
Test Details	Clause no. 5.8, 5.9, 7.6.3.7, and 7.6.3.8
Test Setup	1. Fully charged cell, mono-block, or battery bank. 2. Controlled DC charging power supply capable of I = C/10 ampere output. 3. Variable resistive load bank for constant current I = C/10 discharge. 4. Calibrated DC ammeter, voltmeter, and timer . 5. Data logger or storage oscilloscope
Test Procedure	1. Fully charge the cell/ mono-block/battery as per manufacturer instructions. 2. Discharge the unit at a constant current of I = C/10 amperes down to an end voltage of 1.75V/cell (10.5V/mono-block). 3. Calculate and record the exact delivered capacity in ampere-hours (AH_delivered1) and average discharge voltage (V_discharge). 4. Recharge the unit at the same constant current rate (I = C/10) for the exact number of ampere-hours delivered during the initial discharge (AH_put in = AH_delivered1) and log the average recharge voltage (V_recharge). 5. Perform a second discharge at I = C/10 rate down to the same cut-off voltage of 1.75V/cell (10.5V/mono-block) and record AH_delivered2. 6. calculate AH Efficiency (%) = (AH_delivered2/AH_put in) x 100 7. Calculate WH Efficiency (%) = AH Efficiency (%) x (V_discharge/V_recharge)
Test limits	1. Ampere-Hour (AH) Efficiency shall not be less than 90%. 2. Watt-Hour (WH) Efficiency shall not be less than 80% .
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-9 (Oxygen Recombination Efficiency Test)
Test Details	Clause no. 6.2 and 7.6.4.1
Test Setup	1. Fully formed cell, mono-block, or battery. 2. DC charging power supply capable of controlled low-current outputs (C/100 and C/200 charge rates). 3. Sealed gas collection jig equipped with a discharge gas detector and collector tube. 4. Water bath set up with gas outlet submerged no more than 50 mm below the water surface. 5. Calibrated atmospheric pressure gauge, temperature logger, and timer.
Test Procedure	1. Overcharge the fully charged cell/mono-block/battery continuously at a constant current of I = C/100 amperes for 96 consecutive hours. 2. Install the gas collection apparatus and immediately switch to a continuous charge current of I = C/200 amperes for an additional 24 hours. 3. Immediately after completing the 24-hour C/200 charge, begin collecting all emitted gases for a period of exactly 1 hour. 4. Maintain the ambient room temperature at 27 +/- 10 Deg Celsius throughout collection, ensuring the outlet pipe remains 50 mm underwater. 5. Measure and record ambient temperature (t in C), atmospheric pressure (in kPa), total emitted gas volume (v in ml), and charge current put in during collection (Q in AH). 6. Calculate normalized emitted gas volume (V) per AH of electricity using formula :V = P/101.3 *298/(t+273) *v/Q*1/n, where n - number of cells under test. 7. Compute Gas recombination efficiency (%) = (1-V/684)*100
Test limits	The oxygen recombination efficiency of the cell/mono-block/battery shall be higher than 95% when charged at a C/3.33 rate under normal operating conditions.

Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-10 (Service Life / Ageing Test)**
Test Details	Clause no. 5.12, 6.5, 6.6, 6.7 and 7.6.4.4
Test Setup	1. Fully charged cell or mono-block 2. Temperature-regulated chamber 3. DC charging power supply 4. Variable resistive load bank 5. Optical callipers/micrometers, grid thickness gauges, and structural inspection jigs to evaluate positive plate growth, grid corrosion depth, and active material shedding.
Test Procedure	1. Fully charge the selected cell/mono-block and place it inside the temperature chamber maintained at 55 ± 3 deg Celsius until thermal equilibrium is reached and discharge at a C/3 rate (0.333C) for 3 hours. 2. Recharge at a constant voltage of 2.4V/cell (14.4 V/mono-block) with charging current limited to 0.40 times Rated Capacity for 9 hours. 3. Repeat this 12-hour charge/discharge cycle 25 consecutive times to complete one life unit. 4. Perform a C/3 (0.333 X C) discharge test at 35 deg Celsius for the designated duration as per Annexure B of the GR. 5. Bring the unit to ambient room temperature and perform a standard C/10 capacity test. 6. If the capacity corrected to 27 deg Celsius is more than 80% of its original test capacity, subject the unit to the next life unit cycle and repeat until the unit's capacity falls below 80% of its original test capacity.

	7. Plot the results on an Arrhenius graph and extrapolate to project total cycle life at 35 deg Celsius. 8. Safely discharge, neutralize, and dismantle the cell/mono-block container following the completion of the life unit testing and perform a detailed teardown inspection of the plate group and separator assemblies. 9. Clean positive grids and measure corrosion depth/cross-sectional loss using precision gauges and collect sloughed active material from the bottom of the container/separator pockets, to verify absence of mud-rest accumulation, and confirm zero short circuits or separator bridging. 10. Measure linear horizontal/vertical dimensional growth of the positive plates as compared to pre-test baseline dimensions.
Test limits	1. The Cell/Mono-block/Battery shall be capable of giving more than 1400 DOD(up to 80%) cycles at an average temperature of 35 degree Celsius . 2. Grid corrosion rate shall not exceed 0.05 mm/year under normal operating conditions. 3. Operating at C/10 charge and C/6 discharge under average 35 deg Celsius ambient conditions shall not cause short circuits or separator bridging due to active material shedding. 4. Total linear positive plate growth shall be less than 8% of the total initial plate dimensions over its operating life.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-11 (Thermal Run-away Test)
Test Details	Clause no. 6.8 and 7.6.4.5
Test Setup	1. Fully charged single cell or mono-block. 2. Environmental temperature-controlled chamber 3. Constant voltage DC charging power supply 4. Precision surface temperature sensors attached directly to the cell/mono-block container walls. 5. Calibrated DC ammeter, voltmeter, and fast-sampling data logging system for continuous thermal and current monitoring.
Test Procedure	1. Place the fully charged cell/mono-block inside the constant temperature chamber pre-set to 75 ± 3 deg Celsius. 2. Hold the unit inside the chamber until its surface temperature completely stabilizes at 75 ± 3 deg Celsius. 3. Once surface temperature stabilizes at 75 ± 3 deg Celsius, connect the unit to the DC power supply and initiate continuous charging at a constant voltage of 2.33V/cell (13.98V/mono-block) for 72 hours. 4. Continuously monitor and record charging current, applied terminal voltage, and surface temperature profiles throughout the test duration and continue the test until both the charging current and the surface temperature becomes stable. 5. In case of any any signs of thermal runaway occurs immediately discontinue the test.
Test limits	1. The cell, mono-block, or battery shall not exhibit thermal runaway while operating in elevated environmental conditions (75 deg Celsius chamber temperature) at the specified charge rate. 2. The unit shall not lead to electrolyte dry-out throughout its operational life under normal operating conditions. 3. Both charging current and surface temperature must reach a stable steady-state without thermal acceleration.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-12 (Gassing Test)
Test Details	Clause no. 6.4 and 7.6.4.3
Test Setup	1. Fully charged cell or mono-block. 2. Sealed gas collection jig equipped with discharge tube and collection vessel. 3. Precision Hydrogen (H2) gas analyzer / Gas Chromatograph calibrated 4. Environmental temperature-controlled chamber 5. Manufacturer-provided room sizing charts, data sheets, and ventilation calculation models across C/10 charge rate and C/3, C/4, C/5, C/6, C/8, C/10, C/20, C/72, and C/120 discharge rates.
Test Procedure	1. Connect the gas collection apparatus to the cell/mono-block vent outlet during discharge cycles. 2. Collect the evolved gasses continuously during operation at controlled operating temperatures. 3. Analyze the collected gas sample using the calibrated gas analyzer/chromatograph to measure the exact percentage and volume of hydrogen emitted and measure the hydrogen evolution rate at ambient room temperature and at elevated/reduced temperatures to verify temperature dependence. 4. Cross-examine the measured hydrogen emission levels against the manufacturer's technical charts and room volume guidelines for 12-cell and 24-cell battery strings across all specified rates (C/10 charge; C/3, C/4, C/5, C/6, C/8, C/10, C/20, C/72, and C/120 discharge rates).
Test limits	1. Hydrogen gas evolved from the unit shall at no stage exceed 200 ppm relative to the operating room air volume. 2. Total hydrogen accumulation in the battery room shall strictly remain below 1.0% under all specified operating, charging, and discharging conditions.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-13 (Float VoltageTest)
Test Details	For Clause no. 5.3 and 7.6.3.3
Test Setup	1. Fully charged cell, mono-block, or battery bank. 2. Controlled DC power supply 3. Variable resistive load bank 4. Calibrated DC ammeter, precision voltmeter, and automated time logger.
Test Procedure	1. Discharge the fully charged cell/mono-block at a constant rate of C/10 discharge and record the total discharge duration and delivered initial capacity (C). 2. Immediately switch the unit to the DC power supply and recharge continuously for 10 hours and immediately perform a C/10 discharge test to measure recovered capacity. 3. Fully discharge again, recharge under the same parameters for 7 days and perform a C/10 discharge test to measure recovered capacity
Test limits	1. All the cells in a battery shall be designed for continuous float operation at the specified float voltage throughout the life. 2. Float voltage of each cell in the string shall be within 0.05V of the average float voltage/cell. 3. After the period of seven days the voltage of each cell in the battery shall be within 0.05V of the average voltage/cell.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-14 (Cell Voltage and capacity matching test)
Test Details	Clause no. 5.11, 5.11.1.1, 5.11.1.2, 5.11.2.1, 5.11.2.2, 7.6.3.10
Test Setup	1. Fully charged battery bank consisting of individual cells 2. Calibrated digital battery conductance meter / internal impedance analyzer. 3. Precision calibrated DC voltmeter 4. Surface temperature sensor / contact thermometer.
Test Procedure	1. Fully charge the battery bank in accordance with manufacturer guidelines and allow it to rest on open circuit until temperature stabilizes. 2. Measure and record the open-circuit voltage of each individual cell or mono-block in the battery string. 3. 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. 4. Calculate the discharge capacity of each cell and determine the difference between the highest and lowest cell capacities. 5. Recharge the battery at C/10 rate until fully charged and record the float/charge voltage of each individual cell. 6. Compare the highest and lowest float/charge voltages and capacities to verify compliance with the specified matching limits.
Test limits	1. In case of parallel cell matching, 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. 2. In case of series cell matching, 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 0.1V. 3. In case of 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. 4. In case of series capacity matching, the difference between

	the highest and lowest cell capacities in a cell module string shall not be more than 8% of their rated capacity.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	Test Case-15 (Nuts, Bolts & Washers Test)
Test Details	Clause no. 3.8, 7.6.1.3.6
Test Setup	1. Test samples of nuts, bolts, and washers (Copper, Brass, or Stainless Steel). 2. 30% concentrated sulphuric acid solution 3. Acid-resistant glass beaker/container with lid. 4. Lead coating thickness gauge / micrometer 5. Timer / Stop clock.
Test Procedure	1. Visually verify that the material of the nuts, bolts, and washers is copper, brass, or stainless steel. 2. For copper or brass hardware, measure the thickness of the lead coating using the coating measurement apparatus in accordance with BIS 6848. 3. Prepare a 30% concentrated sulphuric acid solution in a clean glass container. 4. Immerse the test samples (nuts, bolts, and washers) completely in the 30% sulphuric acid solution. 5. Keep the samples immersed undisturbed for a period of not less than 24 hours. 6. After 24 hours, inspect the acid solution for clarity or color change, and inspect the test samples for corrosion or deterioration.

Test limits	1. Stainless steel fasteners can be used without lead coating. Copper or brass fasteners must have an effective lead coating not less than 0.025 mm thick in compliance with BIS 6848 (latest issue). 2. The 30% concentrated sulphuric acid solution shall remain clear at the end of the 24-hour immersion period with no signs of chemical reaction or dissolution of base metal.
Expected Results	Check measurement accuracy and limit as specified in GR.

I. SUMMARY OF TEST RESULTS

TEC Standard No._____

TEC Guide No._____

Equipment name & Model No._____

Clause No.	*Compliance* *(Complied /Not Complied / Submitted/Not Submitted / Not Applicable)*	*Remarks / Test Report Annexure No.*

[Add as per requirement]

Date:

Place:

Signature & Name of TEC testing Officer /

* Signature of Applicant / Authorized Signatory

* *Section J as given above is also to be submitted by the Applicant/ Authorised signatory as part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.*