

WITNESS TEST REPORT



EASTMAN AUTO & POWER LTD

REPORT NUMBER : TUV/PTL/23-24/SFTY-WT/0012
JOB ORDER NUMBER : 8118790131

This test report consists of 28 pages including this cover letter

TESTING LABORATORY:

TUV INDIA PVT. LTD,
ANJANI PALLADIUM, 203 & 204,
SECOND FLOOR AND
MEZZANINE FLOOR, 104B,
SURVEY NO.126/1, BANER MAIN
ROAD, BANER, PUNE 411045,
MAHARASHTRA, INDIA.
TEL NO: + (91) 20-67113116
EMAIL ID: ksneha@tuv-nord.com
WEBSITE: WWW.TUV-NORD.COM

SERVICE REQUESTED BY:

EASTMAN AUTO & POWER LTD
Khasra No. 146 to 150,151/1,151/2,
166, 58,67 to 73, Headbast No.
200, Village Mouja Bated, Pragna
Doon, Baddi, Solan, Himachal
Pradesh, 174103.
Mob.: 9205490450
E-mail:
rajan.chauhan@eaplword.com


REPORT ISSUED TO:

EASTMAN AUTO & POWER LTD
Khasra No. 146 to 150,151/1,151/2,
166, 58,67 to 73, Headbast No.
200, Village Mouja Bated, Pragna
Doon, Baddi, Solan, Himachal
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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 May 2023




PRODUCT DETAILS:

Test item :	TUBULAR GEL BATTERY		
Model Number(#)	EM200PT		
Serial No.:(#)	2218B2UEEV4S98345, 2218B2UEEV4S98346, 2218B2UEEV4S98347, 2218B2UEEV4S98348, 2218B2UEEV4S98349, 2218B2UEEV4S98350, 2218B2UEEV4S98351, 2218B2UEEV4S98352.		
Trademark:			
Make(#)	EASTMAN AUTO & POWER LTD		
Sample ID:	--		
Number of Samples	08		
Date of receipt:	28/03/2022		
Condition of EUT on receipt	Good		
Applicable Standard/ test specification:	IEC 60896-21:2004 (Clause No. 6.2, 6.3,6.4, 6.5, 6.6 ,6.7, 6.9, 6.10, 6.11, 6.12, 6.17, 6.18, 6.19, 6.21)		
Test Result:	The test item passed /failed the test specification(s).		
Declaration of Conformity:	Declaration of conformity of results is based on as per standard limits Or criteria.		
Other Aspects:	This test report relates to the test sample submitted		
Testing (Start date)	28 March 2022	End Date	29 May 2023
Test Site Ambient Condition	Temperature in °C	25 ± 3°C	
	Relative humidity in %	45% - 70% RH	
	Atmospheric pressure in Hpa (If applicable)	--	
Date of issue	31 May 2023		
Authorized By :		Issued by:	
 			
Mr. Anand Vedpathak (Head-Product Testing Laboratory)		Sneha Mandve / Executive – Customer Relation	
Date: 31/05/2023		Date: 31/05/2023	



Report No: TUV/PTL/23-24/SFTY-WT/0012

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Product Ratings	12V, 200Ah	
EUT Environment(#):	Operating temperature range: -20 to 55 °C	
Photographs Pages	Annexure I: photograph of equipment under test (Pages 28 of 28)	
Any other Document attached	N/A	
Tested by (If any)	Amit Rana (EASTMAN AUTO & POWER LTD.)	
<input checked="" type="checkbox"/> Testing Laboratory	TUV INDIA PVT. LTD,	
Testing location/ address :	EASTMAN AUTO & POWER LTD Khasra No. 146 to 150,151/1,151/2, 166, 58,67 to 73, Headbast No. 200, Village Mouja Bated, Pragna Doon, Baddi, Solan, Himachal Pradesh, 174103.	
Witnessed by :	Ankush kare (Sr. Test Engineer)	
Reviewed by:	Mr. Praveen Kumar Mishra (Sr. Safety Engineer)	
Authorized By :	Mr. Anand Vedpathak (Head-Product Testing Laboratory)	



Note: - # Marks represents the details Specified / given by Customer only.

TUV India Private Limited has the following Accreditations/ Recognition:

S.L No	Accreditation Bodies	Certificate Number
1	National Accreditation Board for Testing and Calibration Laboratories (NABL)	TC-5237
2	Bureau of Indian Standards (BIS)	OSL- 7139026
3	Telecommunication Engineering Center (TEC)	TEC/MRA/CAB/IND-D/51

Disclaimer

1. The Released Test Report/s relates ONLY to the specific sample/s submitted for testing and under the stated conditions
2. Any corrections/erasures invalidate the Test Reports. TUV India does not accept any liability whatsoever for the tampering or any unlawful or inadvertent alteration of documents that have been handed over to the Customer.
3. Any discrepancy in the Test report should be brought to the notice of TUV India within 1 (One) Month from the date of issue unless the query raised by regulatory or accreditation body.
4. Test Reports / Certificates or/and any associated attachments shall NOT be copied/reproduced, except IN FULL, without the prior written consent of TUV India.
5. All services rendered by TUV India will be treated as strictly Confidential.
6. TUV India will respond to clarifications requested by the Customer for a maximum period of 1 (One) Month from the date of receipt by the Customer. Samples will not be retained by TUV India after testing is completed or as applicable regulatory requirements
7. For any Complaints / Suggestions please email to: ksneha@tuv-nord.com

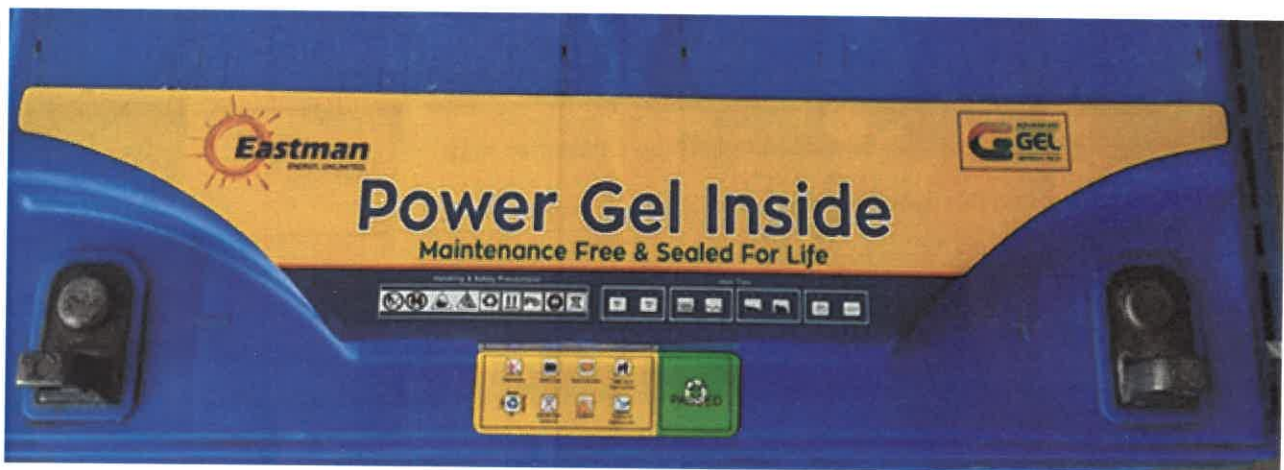
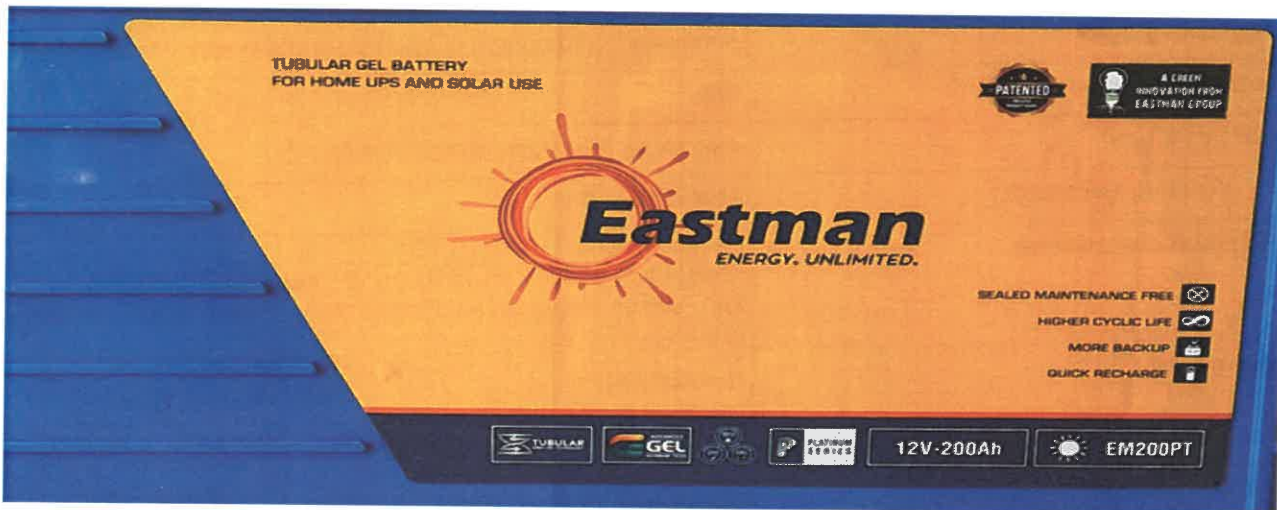
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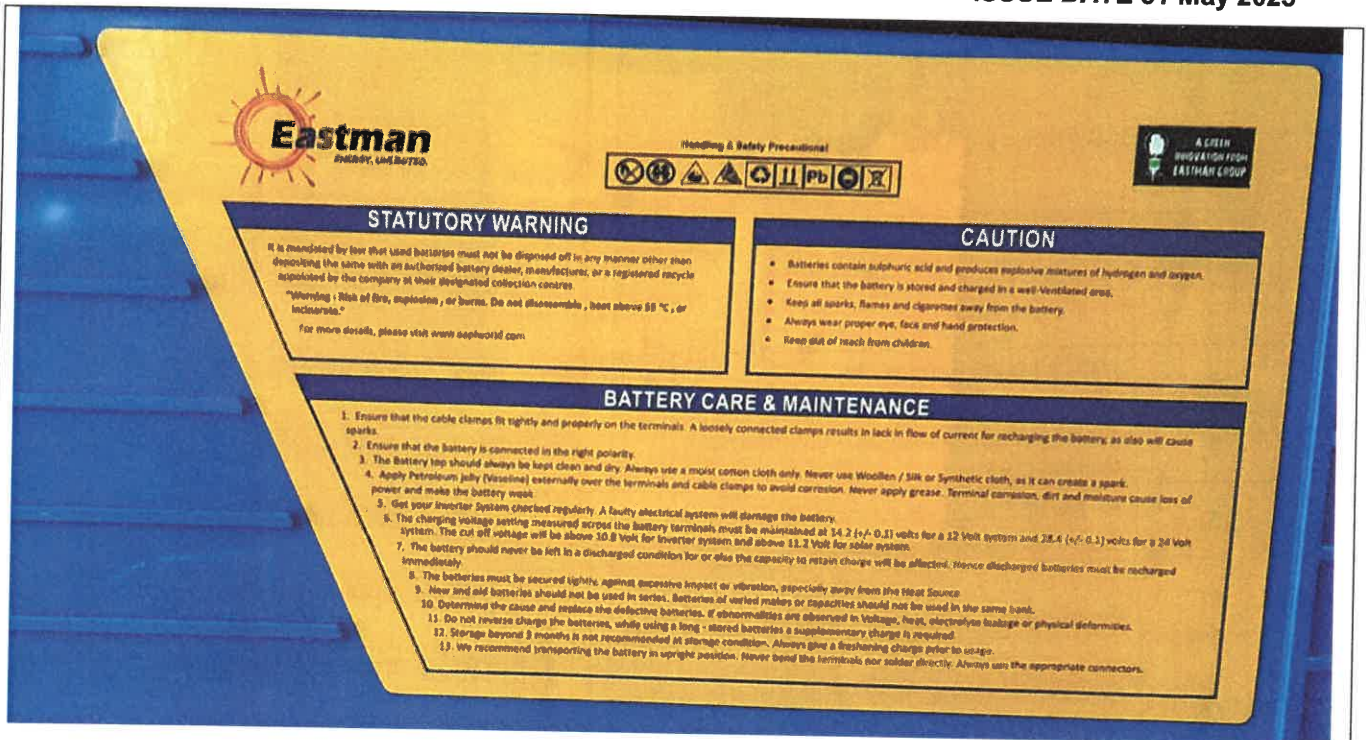
Section 1: Description of Equipment under test #

TUBULAR GEL BATTERY FOR HOME UPS AND SOLAR USE

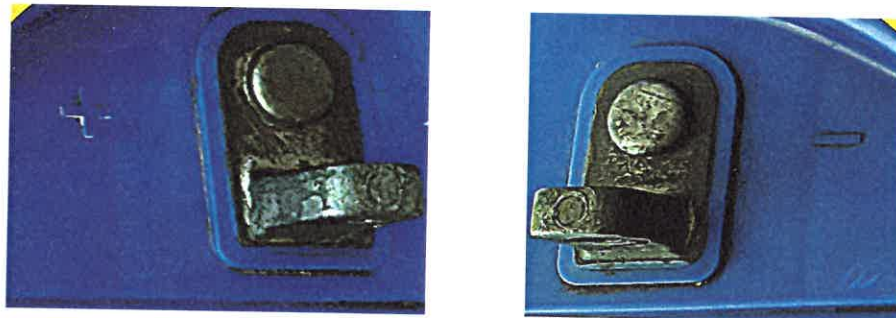
Copy of Marking Label :



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Terminal polarity marking:



Section 2: Test items particulars:

Section 2: Test items particulars :

Supply connection: 12V DC

Through this report a point is used as the decimal separator



Section 3: Summary of Test Results

Test No.	Test Parameter	Standard & Clause Number	Result
1.	High Current Tolerance	IEC 60896-21:2004 and Clause 6.2	Pass
2.	Short circuit current and d.c internal resistance	IEC 60896-21:2004 and Clause 6.3	Pass
3.	Protection against internal ignition from external spark sources	IEC 60896-21:2004 and Clause 6.4	Pass
4.	Protection against ground short propensity	IEC 60896-21:2004 and Clause 6.5	Pass
5.	Content and durability of required marking	IEC 60896-21:2004 and Clause 6.6	Pass
6.	Material Identification	IEC 60896-21:2004 and Clause 6.7	Pass
7.	Flammability rating of material	IEC 60896-21:2004 and Clause 6.9	Pass
8.	Intercell connector performance	IEC 60896-21:2004 and Clause 6.10	Pass
9.	Discharge Capacity	IEC 60896-21:2004 and Clause 6.11	Pass
10.	Charge retention during Storage	IEC 60896-21:2004 and Clause 6.12	Pass
11.	Abusive over discharge	IEC 60896-21:2004 and Clause 6.17	Pass
12.	Thermal Runway Sensitivity	IEC 60896-21:2004 and Clause 6.18	Pass
13.	Low temperature Sensitivity	IEC 60896-21:2004 and Clause 6.19	Pass
14.	Stability against mechanical abuse of units during installation.	IEC 60896-21:2004 and Clause 6.21	Pass

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REPORT NO: TUV/PTL/23-24/SFTY-WT/0012

ISSUE DATE 31 May 2023

Section 4: Equipment used during the tests:

Serial No.	Test Equipment	Unique Equipment ID	Calibration Due Date
1	Battery life cycle tester	CKT1/1/Life cycle tester-1	27-7-2023
2	Digital weighing balance	PTL-38	27-07-2023
3	Digital Vernier caliper	001211	28-7-2023
4	High rated discharge tester	HRD-01	30-7-2023
5	Digital multi-meter	PTL-35	28-7-2023
6	Digital wall clock	DC-TL-02	25-05-2024
7	Temperature and RH data logger	PTL-50	01-08-2023



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Report No: TUV/PTL/23-24/SFTY-WT/0012

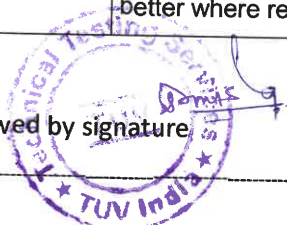
Issue Date 31 MAY 2023

IEC 60896-21

Clause	Requirement + Test	Result - Remark	Verdict
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4	Functional characteristics	Test performed as per table 1, table 2, table 3	P
5	Test set-up (IEC 60896-21:2004)	See below	P
5.1	Accuracy of measuring instruments	See below	P
5.1.1	Voltage measurements	See below	P
	The instruments used shall be of an accuracy class 0,5 or better where required. The resistance of the voltmeters shall be at least 10 000 Ω/V .	Complies	P
5.1.2	Current measurements	See below	P
	The instruments used shall be of an accuracy class 0,5 or better where required.	Complies	P
5.1.3	Temperature measurement	See below	P
	The instruments used shall have a resolution of 1 K. The absolute accuracy of the instruments shall be 1 K or better where required.	Complies	P
5.1.4	Time measurements	See below	P
	The time measurements shall have of an accuracy of ± 1 % or better where required.	Complies	P
5.1.5	Length measurements	See below	P
	The instruments used shall have an accuracy of $\pm 0,1$ % or better where required.	Complies	P
5.1.6	Weight measurements	See below	P
	The instruments used shall have an accuracy of ± 1 % or better where required.	Complies	P
5.1.7	Gas volume measurements	See below	P
	The instruments used shall have an accuracy of ± 5 % or better where required.	Complies	P
5.1.8	Gas pressure measurements	See below	P
	The instruments used shall have an accuracy of ± 10 % or better where required.	Complies	P

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IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

5.2	Selection of test units	See below	P
	The units to be used for type testing according to this part of IEC 60896 shall be selected in accordance with the procedures as standard specified	Complies	P
5.3	General test features and rules	See below	P
5.3.1	The test units shall not undergo any maintenance operations such as water or electrolyte additions or withdrawals during the entire duration of a test.	Complies	P
5.3.2	The test units shall be tested in the position specified by the manufacturer in the relevant technical documentation of the product range except for those cases in which a particular position is specified in the test clause. The position used in any given test shall be reported in the relevant test documentation.	Battery test as per manufacturer instruction and position of battery is also specified in provided documents	P
5.3.3	The test units shall always be tested fully charged with the method and duration of charge being exclusively that specified by the manufacturer in the relevant technical documentation of the product range except for those cases in which a particular method or duration is specified in the test subclause. The charge methods and duration used in each test shall be reported in the relevant test documentation.	Tested as per standard and instructions provided in documents	P
5.3.4	Whenever there is a significant change in a specified design feature, material, manufacturing process, relevant quality inspection and test procedures of the manufacturing location(s) of a product range, the relevant type test(s) shall be repeated to ensure that the affected product range continues to be in compliance with the defined Safe operation, Performance and Durability requirements for the intended application.	No such changes	N/A
5.4	Number of test units	See below	P





Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21

Clause	Requirement + Test	Result - Remark	Verdict
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Clause	Requirement + Test	Result - Remark	Verdict																																	
	<p align="center">Table 4 – Safe operation characteristics</p> <table border="1"> <thead> <tr> <th>Test Clause</th> <th>Measures</th> <th>Number of test units</th> </tr> </thead> <tbody> <tr><td>6.1</td><td>Gas emission</td><td>6 cells or 3 monobloc batteries</td></tr> <tr><td>6.2</td><td>High current tolerance</td><td>3 cells or 3 monobloc batteries</td></tr> <tr><td>6.3</td><td>Short circuit current and d.c. internal resistance</td><td>3 cells or 3 monobloc batteries</td></tr> <tr><td>6.4</td><td>Protection against internal ignition from external spark sources</td><td>3 valve assemblies</td></tr> <tr><td>6.5</td><td>Protection against ground short propensity</td><td>1 cell or 1 monobloc battery</td></tr> <tr><td>6.6</td><td>Content and durability of required markings</td><td>3 samples</td></tr> <tr><td>6.7</td><td>Material identification</td><td>1 cover or 1 case sample</td></tr> <tr><td>6.8</td><td>Valve operations</td><td>3 cells or 3 monobloc batteries</td></tr> <tr><td>6.9</td><td>Flammability rating of materials</td><td>1 sample per material</td></tr> <tr><td>6.10</td><td>Intercell connector performance</td><td>6 cells or 6 monobloc batteries</td></tr> </tbody> </table>	Test Clause	Measures	Number of test units	6.1	Gas emission	6 cells or 3 monobloc batteries	6.2	High current tolerance	3 cells or 3 monobloc batteries	6.3	Short circuit current and d.c. internal resistance	3 cells or 3 monobloc batteries	6.4	Protection against internal ignition from external spark sources	3 valve assemblies	6.5	Protection against ground short propensity	1 cell or 1 monobloc battery	6.6	Content and durability of required markings	3 samples	6.7	Material identification	1 cover or 1 case sample	6.8	Valve operations	3 cells or 3 monobloc batteries	6.9	Flammability rating of materials	1 sample per material	6.10	Intercell connector performance	6 cells or 6 monobloc batteries	See cl. No. 6.1 to 6.10	P
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5.5	Suggested test sequence	See below	P																																	
	Multiple tests on the same units are allowed. However, the test sequence should be planned carefully to ensure that the execution of one test does not disturb or unduly influence the outcome of a subsequent test or cause hidden safety problems. In some cases, a test clause may proscribe a sequence of tests. Separate units may be used for each test unless otherwise specified. The manufacturer makes the final decision on the test sequence. The adopted test sequence shall be recorded in the relevant test documentation.		P																																	
5.6	Customer test	No such test requirement	N/A																																	

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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

5.6.1	The test units and test to be used for acceptance or commissioning tests shall be selected and defined by a joint agreement between the battery supplier and battery user.	See above	N/A
	For an acceptance or commissioning capacity test, a discharge at the 3 h rate to a final voltage of 1,70 Vpc or as agreed upon between battery supplier and battery user, shall be selected.	See above	N/A


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IEC 60896-21

Clause	Requirement + Test	Result - Remark	Verdict
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6	Test methods AND Requirements and characteristics	See below	P
6.2	High current tolerance	See table 6.2	P
6.3	Short-circuit current and d.c. internal resistance	See table 6.3	P
6.4	Protection against internal ignition from external spark sources	Refer Test report no. URS/LAB/01/RID/22-23/1630	P
6.5	Protection against ground short propensity	Refer Test report no. URS/LAB/01/RID/22-23/1630	P
6.6	Content and durability of required markings	See table 6.6	P
6.7	Material identification	See table 6.7	P
6.9	Flammability rating of materials	See table 6.9	P
6.10	Intercell connector performance	See table 6.10	P
6.11	Discharge capacity	See table 6.11	P
6.12	Charge retention during storage	See table 6.12	P
6.17	Abusive over-discharge	Refer Test report no. URS/LAB/01/RID/22-23/1630	P
6.18	Thermal runaway sensitivity	Refer Test report no. URS/LAB/01/RID/22-23/1630	P
6.19	Low temperature sensitivity	Refer Test report no. URS/LAB/01/RID/22-23/1630	P
6.21	Stability against mechanical abuse of units during installation	See table 6.21	P

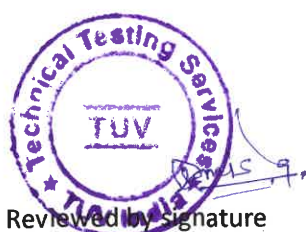


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IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.2	High current tolerance			Verdict:	P
Test method:	Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.				
	<p>1. The test units shall be discharged for 30 s with a current equal to 3 times the 5 min rate current (to U_{final} 1,80 V_{pc} at 20 °C or 25 °C) or with a current equal to the maximum allowable discharge current, both as specified by the manufacturer in the relevant technical documentation of the product range.</p> <p>2. After the completion of the specified discharge duration, the test units shall stand for 5 min in open circuit and their voltage measured and reported.</p>				
Test result:					
Sample No.	1	2	3	Requirements	
Discharge current = ($U_{final}=1.80V_{pc}$)	90A	90A	90A	Show evidence of no incipient melting or of no loss of electrical continuity after 30 s of high current flow	
The battery status after large current	No terminal melting, No strip melting and Exterior appearance normal	No terminal melting, No strip melting and Exterior appearance normal	No terminal melting, No strip melting and Exterior appearance normal		
Voltage after open circuit for 5min (V)	13.27V (2.21)	13.29 (2.22)	13.33V (2.22)	Voltage of unit >2,0 V_{pc}	
Supplementary information: Discharge current 90A as specified by the manufacturer.					



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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.3	Short-circuit current and d.c. internal resistance			Verdict:	P
Test method:	<p>Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.</p> <p>1. The short circuit current shall be defined by determining two data pairs in the following way:</p> <p>a) First data pair (U_a, I_a) After 20 s of discharge at the current $I_a = 4 \times I_{10}$, the voltage and current shall be recorded to give the first data pair. The current shall be interrupted after 25 s maximum and, without recharge and after an open circuit stand of 5 min, the second data pair shall be determined.</p> <p>b) Second data pairs (U_b, I_b) After 5 s of discharge at the current $I_b = 20 \times I_{10}$, the voltage and current shall be recorded to give the second data pair.</p> <p>2. Short circuit current $I_{sc} = [(U_a \times I_b) - (U_b \times I_a)] / (U_a - U_b)$ in amperes</p> <p>Internal resistance $R_i = (U_a - U_b) / (I_b - I_a)$ in ohms</p>				
Test result:					
Model name:	Sample No:	Short circuit current I_{sc} (A)	Internal resistance R_i (Ω)	Remark	
EM200PT	1	1595.2	0.0078	Actual capacity $C_a > C_3$	
	2	1574.8	0.0079		
	3	1576.1	0.0079		
Supplementary information: $I_{10} = 18$ A as specified by the manufacturer.					



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IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.4	Protection against internal ignition from external spark sources	Verdict:	P
Test method:	<ol style="list-style-type: none"> 1. The test shall be carried out at an ambient temperature between 15 °C and 30 °C. 2. Fill the test fixture with water to a level 3 mm below the underside of the top. Place the hold-down frame over a 0,025 mm thickness of polyethylene film cut as shown in figure 1. Place the frame, with the film in place, over the four studs so that the film covers the open area between the fixture and the frame. Tighten the frame down finger tight with wing nuts to ensure a gas-tight seal around the gasket. Fit the vent system to be tested into the fixture. 3. The whole system shall be checked for gas leakage at any place other than the vent opening, for example with a soap solution whilst charging the gas source battery. 4. Within 1 h of charging the gas source battery commence the gassing test or otherwise commence the spark test. 5. The valve assembly is deemed to have passed the test when no explosion or rapid combustion event occurred within the test fixture. 		
Requirements	No evidence of rapid combustion or explosion beyond valve/barrier assemblies		
Test result:			
Sample No.			Remark
Supplementary information: Refer reference report no. URS/LAB/01/RID/22-23/1630			



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Table 6.5	Protection against ground short propensity	Verdict:	P	
Test method:				
<p>Each battery has an actual capacity $C_a \geq 0,95C_3$ and was fully charged.</p> <ol style="list-style-type: none"> 1. The case to cover seal line of the unit shall be placed in contact with a metallic surface. 2. The unit shall be placed horizontally and sequentially on all four possible faces according to the time schedule in 5 and 6, and float charged, with Uflo as specified by the manufacturer, at a room temperature between 20 °C and 25 °C. 3. The units shall be connected, to a circuit which applies a d.c. voltage of at least 500 V \pm 5 V between one terminal and the metallic surface (aluminium foil strip) in contact with the seal line. 4. The negative terminal of the d.c. voltage source shall be connected to the terminal of the unit(s) and the positive terminal to the aluminium foil strip. 5. The unit shall be placed horizontally first on face 1 for 30 days or until either electrolyte leakage or significant ground short current flow (few mA of current) is detected. 6. After 30 days of test, the unit shall be placed horizontally for 7 days on face 2, followed by 7 days on face 3 followed by 7 days on face 4 or until either electrolyte leakage or significant ground short current flow is detected. 7. The presence or absence of ground short/leakage phenomena shall be reported. 				
Requirements	No evidence of ground short and leakage phenomena			
Test result:				
Sample No.	Electrolyte leakage?	Ground short?	Leakage current measured?	Remark
Supplementary information: Refer reference report no. URS/LAB/01/RID/22-23/1630				



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IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.6	Content and durability of required markings	Verdict:	P
Test method:			
The test shall be carried out on three of the required markings. Test with water and aliphatic solvent.			
1. 1# label is rubbed for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit, dried in air and then inspected visually.			
Test with neutralizing solutions			
2. 2# label is rubbed for 15 s with a piece of cloth soaked with a saturated solution of sodium carbonate (Na ₂ CO ₃) or bicarbonate (NaHCO ₃) in water, dried in air and then inspected visually.			
Test with electrolyte			
3. 3# label is rubbed for 15 s with a piece of cloth soaked with a solution of 40 % in weight of H ₂ SO ₄ in water, washed with water, dried in air and then inspected visually.			
Requirements	Information shall remain readable after exposure to chemicals and remain in place		
Test result:			
Sample No.	Phenomena observed	Remark	
1	After the test label is still visible clearly.	complies	
2	After the test label is still visible clearly.	complies	
3	After the test label is still visible clearly.	complies	

6.6	Content and durability of required markings	Remark:	Verdict:
	Technical information to be present	See below	P
	Polarity sign at the positive terminal(s) with a + symbol radius of at least 6 mm	Marked on the marking label	P
	Manufacturer and/or vendor name		P
	Type designation of unit	EM200PT	P
	At least one rated capacity and its final voltage in Vpc or V per unit at a rate listed in 6.11 of IEC 60896-2-1	Provided	P
	Rated temperature (20 °C or 25 °C) for the capacity value	Provided in document	P
	Float voltage in Vpc or V per unit at a rated temperature of 20 °C and/or 25 °C	Provided in document	P
	Date of manufacture (see Note 1 below) in clear unequivocal mm. yyyy format	Provided in document	P
	ISO warning symbols to be present with 11 mm diameter minimum size and in two contrasting colours	See below	P

Report No: **TUV/PTL/23-24/SFTY-WT/0012**

Issue Date **31 MAY 2023**

IEC 60896-21

Clause	Requirement + Test	Result - Remark	Verdict
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	Warning	provided on the marking label	P
	Electrical danger	provided on the marking label	P
	No open fires and sparks	provided on the marking label	P
	Wear eye protection	provided on the marking label	P
	Environmental protection and recycling symbols to be present	See below	P
	Recycling symbol	provided on the marking label	P
	Crossed out waste bin	provided on the marking label	P



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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.7	Material identification	Verdict:	P
Test method:			
Battery cover or case.			
<ol style="list-style-type: none"> 1. The specified information for material identification shall be selected from the list of abbreviation published in ISO 1043-1. 2. The cover and case shall be visually inspected for a marking showing an ISO 1043-1 defined abbreviation of the name of the polymer(s) forming the bulk of the case and/or cover. 3. The stability of the marking shall be tested, if needed, with the test outlined in 6.6. 			
Requirements	ISO symbol present on the outside of the cover or/and case Symbol shall remain readable after exposure to chemicals and remain in place		
Test result:			
Sample No.	Abbreviation of the name of the polymer(s)	Remark	
Battery cover	PP	Complies	
Battery case	PP	Complies	



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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.9	Requirement for definition of the flammability rating of the materials	Verdict:	P
Test method:			
<ol style="list-style-type: none"> The test shall be carried out with appropriately sized samples of the material used for the manufacture of the cell or monobloc battery case and, if different, also of the cell or monobloc battery cover. The test shall be carried out by an appropriate test laboratory The test method used shall be in accordance with IEC 60707 and IEC 60695-11-10 or equivalent test methods for all of the above. The test result and the resulting flammability classification of the material shall appear on a dated and signed test certificate. 			
Test result:			
Flammability rate level	V-0		
Supplementary information: Test method used as per IEC 60695-11-10.			

Table 6.10	Requirement for performance of the inter-cell connector	Verdict:	P					
Test method:								
<ol style="list-style-type: none"> The test shall be carried out with the cells and monobloc batteries destined for the test of 6.11 (discharge capacity at the $C_{0.25}$ or 0,25 h rate with a current $I_{0.25}$ to $U_{final}=1,60 V_{pc}$) or alternatively with the highest discharge current for a particular unit and intercell connector size as specified/allowed by the manufacturer in the relevant technical documentation of the product range The temperature of the units at the start of the test shall be between 20 °C and 25 °C. The shape, size and construction details and the maximum temperature reached of the intercell connectors during this discharge test shall be reported. 								
Requirements	≤70 °C							
Test result:								
Model	Sample no.	1	2	3	4	5	6	Discharge till 1.60Vpc;
EM200PT	Highest temp. (°C)	35	35	35	35	35	35	
Supplementary information: Tested at discharge current 90A as specified by the manufacturer.								



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IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.11	Discharge capacity	Verdict:	P
Test method:			
<p>Capacity C_{0,25} (0,25 h rate)</p> <ol style="list-style-type: none"> The discharge shall be started within 1 h to 24 h after fully charged. Discharged with a constant current I_{0,25} to U_{final} = 1.60 Vpc. Recorded discharge time and calculated capacity. Corrected the capacity to temperature of 25 °C. θ is the initial temperature, $C_{a25\text{ °C}} = C / [1 + \lambda (\theta - 25)]$ in Ah, (λ = 0,01) <p>Capacity C (1 h rate)</p> <ol style="list-style-type: none"> The discharge shall be started within 1 h to 24 h after fully charged. Discharged with a constant current I₁ to U_{final} = 1.60 Vpc. Recorded discharge time and calculated capacity. Corrected the capacity to temperature of 25 °C. θ is the initial temperature, $C_{a25\text{ °C}} = C / [1 + \lambda (\theta - 25)]$ in Ah, (λ = 0,01) <p>Capacity C₃ (3 h rate)</p> <ol style="list-style-type: none"> The discharge shall be started within 1 h to 24 h after fully charged. Discharged with a constant current I₃ to U_{final} = 1.70 Vpc . Recorded discharge time and calculated capacity. Corrected the capacity to temperature of 25 °C. θ is the initial temperature, $C_{a25\text{ °C}} = C / [1 + \lambda (\theta - 25)]$ in Ah, (λ = 0,006) <p>Capacity C₈ (8 h rate)</p> <ol style="list-style-type: none"> The discharge shall be started within 1 h to 24 h after fully charged. Discharged with a constant current I₈ to U_{final} = 1.75 Vpc . Recorded discharge time and calculated capacity. Corrected the capacity to temperature of 25 °C. θ is the initial temperature, $C_{a25\text{ °C}} = C / [1 + \lambda (\theta - 25)]$ in Ah, (λ = 0,006) <p>Capacity C₁₀ (10 h rate)</p> <ol style="list-style-type: none"> The discharge shall be started within 1 h to 24 h after fully charged. Discharged with a constant current I₁₀ to U_{final} = 1.80 Vpc. Recorded discharge time and calculated capacity. Corrected the capacity to temperature of 25 °C. θ is the initial temperature, $C_{a25\text{ °C}} = C / [1 + \lambda (\theta - 25)]$ in Ah, (λ = 0,006) 			



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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Model name:		EM200PT			
Requirements		$C_a \geq 95\%C_{rt}$			
Sample No:	Capacity C_{10} (Ah)	Capacity C_8 (Ah)	Capacity C_3 (Ah)	Capacity C_1 (Ah)	Remark
C_{rt}	180	168.5	129	90	I10= 18A, I8 = 21.06A, I3 = 43.0A, I1 = 90.0A
95% C_{rt}	$\geq 95\%C_{rt}$	$\geq 95\%C_{rt}$	$\geq 95\%C_{rt}$	$\geq 95\%C_{rt}$	
1	182.98	174.07	130.92	97.77	
2	182.99	172.67	130.91	102.62	
3	182.46	171.66	133.01	102.62	
4	181.63	173.37	133.18	100.94	
5	184.88	172.25	129.63	96.22	
6	181.01	173.03	131.70	102.69	
Supplementary information: Nil					



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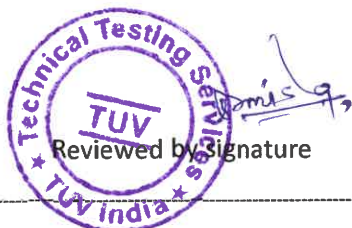
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Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.12	Charge retention during storage	Verdict:	P			
Test method:	Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.					
	<ol style="list-style-type: none"> The units shall be stored at an ambient temperature of $25\text{ }^\circ\text{C} \pm 5\text{ K}$ and fully disconnected from any external circuit. After 180 days of storage the units shall be discharged without any prior recharge so that their actual capacity after storage C_{ast} (3 h – U_{final} 1.70 V_{pc} at the selected reference temperature) can be determined. The charge retention factor C_{rf} shall be expressed as percentage, and is equal to $C_{rf} = (C_{ast} \times 100) / C_a \quad (\%)$ The six individual values of C_{rf} shall be reported 					
Requirements	$C_{rf} \geq 70\%$					
Test result:						
Model name:	EM200PT					
Sample No.	1	2	3	4	5	6
C_{ast} (Ah)	122.51	123.41	123.15	125.23	124.71	122.32
C_a (Ah)	139.59	137.72	138.35	139.21	139.48	137.07
C_{rf} (%)	87.76	89.61	89.01	89.96	89.41	89.24



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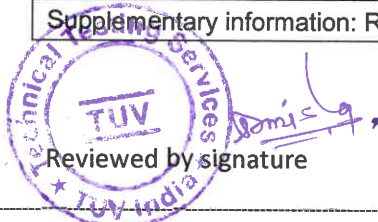


Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.17	Abusive over-discharge	Verdict:	P
Test method:			
<p>Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.</p> <p>One of the 4 units shall be discharged, at a unit temperature of 18 °C to 27 °C, with a current of I_{10} for 3 h and then connected to the remaining 3 fully charged units in series and with the intercell connectors giving, between each units, an air gap of 10 mm or as specified in the appropriate technical documentation of the product range.</p> <p>unbalanced string over-discharge test (four fully charged batteries string)</p> <ol style="list-style-type: none"> 1. This four unit string shall then be discharged, with all unit temperatures between 18 °C to 27 °C, with a current $I = I_{10}$ (U_{final} 1,80 V_{pc}) until the voltage of the three, initially fully charged units reach a total voltage of U_{final} of $3 \times n \times 1,70 V_{pc}$ where n is the number of cells in this substring. 2. After the discharge and a 24 h \pm 0,1 h stand in the discharged state, the four unit string shall be recharged in series for 168 h \pm 0,1 h with a current limited to $I = 2,0 I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C. 3. At the end of the 168 h \pm 0,1 h of charge, the units shall be subjected, as a four unit string, to a capacity test with a constant current of $I = I_3$ to a U_{final} of $4 \times n \times 1,70 V_{pc}$ and the capacity C_a corrected to 20 °C or 25 °C. 4. The capacity C_a of the string shall be referenced to the rated capacity C_{rt} (3 h – U_{final} 1,70 V_{pc} at the selected reference temperature) as shown below and gives the unbalanced over-discharge C_{aod} capacity ratio. This value shall be reported. $C_{aod} = C_a / C_{rt}$ <p>cyclic over-discharge test (three fully charged batteries string)</p> <ol style="list-style-type: none"> 1. The units shall be discharged individually or as a string, with all unit temperatures between 18 °C to 27 °C and with a constant current of $I = I_{10}$ to a voltage U_{final} of $n \times 1,25 V_{pc}$ where n is the number of cells per unit or string. 2. After the discharge and a 1 h \pm 0,1 h stand in the discharged state, the units shall be recharged for 168 h \pm 0,1 h with a current limited to $I = 2,0 I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C. 3. The sequence outlined above shall be repeated 5 times. 4. At the end of the fifth 168 h \pm 0,1 h of charge, the units or the string shall be 5. subjected to a capacity test with a constant current of $I = I_3$ to U_{final} of $n \times 1,70 V_{pc}$ and the capacity C_a corrected to 20 °C or 25 °C. 6. The capacity C_a of each unit or of the string shall be referenced to the rated capacity C_{rt} (3 h – U_{final} 1,70 V_{pc} at the selected reference temperature) as shown below and gives the cyclic over-discharge C_{aoc} capacity ratio. This value(s) shall be reported $C_{aoc} = C_a / C_{rt}$ 			
Requirement:	Caod (%) \geq 80%, Caoc (%) \geq 90%		
Model name:			
Ca (Ah)		Ca (Ah)	
Crt (Ah)		Crt (Ah)	
Caod (%)		Caoc (%)	
Supplementary information: Refer reference report no. URS/LAB/01/RID/22-23/1630			



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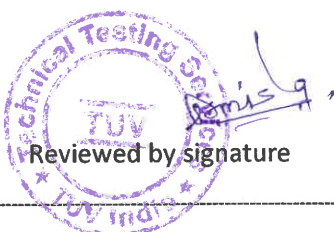


Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.18	Thermal runaway sensitivity	Verdict:	P
Test method:			
<p>Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.</p> <ol style="list-style-type: none"> 1. The units shall be assembled with the intercell connectors. 2. The ambient temperature shall be between 20 °C to 25 °C during the test and any natural airflow across the units shall be slower than 0,5 m.s⁻¹. 3. Temperature probes, with a resolution of 1 K and allowing a continuous registration of the temperature (interval between temperature measurements $\leq 0,25$ h), shall be installed as Figures 7 and 8 4. The string shall be charged with a source of d.c. current and with a voltage as specified below. The current flowing through the string shall be monitored with an appropriate resolution and at an interval, between measurements, of $\leq 0,25$ h. 5. The constant charge voltage, measured at the terminals of the string, shall be set to $n \times 2,45 V_{pc} \pm 0,01 V_{pc}$ throughout the test, where n is the number of cells in the string. 6. The elapsed time of charge to a unit temperature of 60 °C ± 1 K, measured with the probe a) at the surface or the temperature reached after 168 h continuous charge, shall be recorded and the test stopped whichever comes first. 7. The string shall then be cooled down to room temperature in open circuit condition 8. The previously utilized string shall be charged with a source of d.c. current and with a voltage as specified below. The current flowing through the string shall be monitored with an appropriate resolution at an interval between measurements of $\leq 0,25$ h. 9. The constant charge voltage, measured at the terminals of the string, shall be set to $n \times 2,60 V_{pc} \pm 0,01 V_{pc}$ throughout the test, where n is the number of cells in the string. 10. The elapsed time of charge to a temperature of unit 60 °C ± 1 K, measured with the probe a) at the surface or the temperature reached after 168 h continuous charge, shall be recorded and the test stopped whichever comes first. 			
Requirements	Achieve at least 1 week below 60 °C at 2,45 Vpc and at least 24 h below 60 °C at 2,60 Vpc Show ultimate time to 60 °C or ultimate temperature after 168 h at 2,45 Vpc and 2,60 Vpc.		
Test result:			
Model name:	Sample No:	Duration of charge until a unit temperature of 60 °C ± 1 K (probe a) is reached or the effective temperature (probe a) after 168 h of charge with 2,45 Vpc	Duration of charge until a unit temperature of 60 °C ± 1 K (probe a) is reached or the effective temperature (probe a) after 168 h of charge with 2,60 Vpc
Supplementary information: Refer reference report no. URS/LAB/01/RID/22-23/1630			

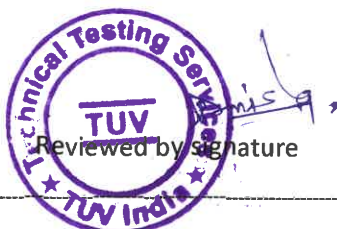


Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.19	Low temperature sensitivity	Verdict:	P
Test method:			
Each battery has an actual capacity $C_a \geq C_3$ and was fully charged.			
<ol style="list-style-type: none"> The units shall be individually discharged with a current of $I = I_{10}$ to an U_{final} of $n \times 1,80 V_{pc}$ at a unit temperature between 18 °C and 27 °C. The discharged units shall then be placed in a test chamber with a forced flow of air having a temperature of $-18 \text{ °C} \pm 2 \text{ K}$. After $72 \text{ h} \pm 1 \text{ h}$ of residence in the test chamber the units shall be withdrawn from the test chamber and, after $24 \text{ h} \pm 1 \text{ h}$ of stand at open circuit, charged in a room with an ambient temperature between $+18$ to $+27 \text{ °C}$ for $168 \text{ h} \pm 0.1 \text{ h}$ with a current limited to $I = 2.0 I_{10}$ and a voltage limited to the float voltage specified by the manufacturer for either 20 °C or 25 °C. The units shall then be individually discharged with a current of $I = I_3$ to an U_{final} of $n \times 1.70 V_{pc}$ and the actual capacity C_a corrected to 20 °C or 25 °C shall be recorded. The capacity C_a of each unit shall be referenced to the rated capacity C_{rt}. ($3 \text{ h} - U_{final} 1.70 V_{pc}$ at the selected reference temperature) as shown below and gives the C_{als} capacity ratio. $C_{als} = C_a / C_{rt}$ These units shall be individually discharged in this second test, before low temperature exposure, with a current of $I = I_3$ to an U_{final} of $n \times 1.70 V_{pc}$ at a unit temperature between 18 °C and 27 °C. 			
Requirements	$C_{als} > 0.95$ and no mechanical damages and report eventual freezing induced damages		
Sample No.			Remark
	$C_a 25 \text{ °C (Ah)}$		$C_a > C_{rt}$
	$C_{rt} \text{ (Ah)}$		$C_a > C_{rt}$
	$C_{als} (\%)$		$>95\%$
Battery status			
Supplementary information: Refer reference report no. URS/LAB/01/RID/22-23/1630			



Report No: **TUV/PTL/23-24/SFTY-WT/0012**

Issue Date **31 MAY 2023**

IEC 60896-21			
Clause	Requirement + Test	Result - Remark	Verdict

Table 6.21	Stability against mechanical abuse of units during installation	Verdict:	P
Test method:			
<p>1. The units shall be dropped according to the height prescriptions of IEC 60068-2-32 and amendment. Two "Free Fall", for resistance against leakages caused by two drops each onto a smooth, level concrete floor from drop heights as specified below:</p> <p>a) Fall from 100 mm for units weighing up to 50 kg</p> <p>b) Fall from 50 mm for units weighing between 50 kg and 100 kg</p> <p>The drop test conditions shall assure, with test arrangements as shown in Figures 9, 10 and 11 below, reproducible impact points for the shortest edge drop impact and the corner impact. The two impacts, per impact type, shall be on the same corner and on the same shortest edge.</p> <p>2. For the corner and edge drops, the unit shall be oriented in such a fashion that a straight line drawn through the struck corner/edge and the unit geometric centre is approximately perpendicular to the impact surface.</p> <p>3. Each of the units shall be inspected, after the two consecutive drops, for gas and liquid leaks with adequate and sensitive means such as a high voltage (2 kV to 5 kV) dielectric breakdown test, helium leak detectors, hydrogen detectors, pH indicator paper and the like and the findings documented and reported.</p>			
Test result:			Pass
Requirements	No leakage detectable after two drops		
Model No.	Sample no.	Drop height	Result
EM200PT	1	50mm	No broken or leakage observed after two drops
	2	Shortest edge drops & Corner drops	No broken or leakage observed after two drops



Report No: TUV/PTL/23-24/SFTY-WT/0012

Issue Date 31 MAY 2023

IEC 60896-21

Clause	Requirement + Test	Result - Remark	Verdict
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Annexure I: photograph of equipment under test



Front View of Equipment under test



TOP View of Equipment Under Test

*****End of Report*****

