Test Report

Applicant	:	Leoch International Technology Limited
Address	:	5th Floor, Xinbaohui Bldg., Nanhai Blvd., Nanshan, Shenzhen, China.
Name of sample	:	Lead-acid battery
Model No.	:	LPG12-240
Receiving Date	:	Jan. 05, 2022
Test Date	:	Jan. 05, 2022 ~ Jan. 10, 2024
Test Location	:	No.47-3, Industrial Road, Zhushan, Dalong Street, Panyu District, Guangzhou, Guangdong, China
Test Method	:	IEC 60896-21:2004 Stationary lead-acid batteries - Part 21: Valve regulated types - Methods of test IEC 60896-22:2004 Stationary lead-acid batteries - Part 22: Valve regulated types – Requirements
Testing Item	:	See the test data page
Decision Rule	:	See the test data page
Conclusion	:	The sample meets the standard test requirements

Shenzhen United Testing Technology Co.,Ltd
Signed for and on behalf of

Liu Ze
Approved Signatory

Jan. 11, 2024
Signatory Date

深圳市优耐检测技术有限公司
Shenzhen United Testing Technology Co.,Ltd.

1、Conclusion

The sample(s) was/were detected and according to the results, the conclusion are as follows:

Test Item(s)		Testing Standard(s)	Decision Rule(s)	Conclusion
Article	Name			
6.1	Gas emission	IEC 60896-21:2004	IEC 60896-22:2004	Pass
6.2	High current tolerance			Pass
6.3	Short circuit current and d.c. internal resistance			Pass
6.4	Protection against internal ignition from external spark sources			Pass
*6.5	Requirement for protection against ground short propensity			Pass
6.6	Content and durability of required markings			Pass
6.7	Material identification			Pass
6.8	Valve operation			Pass
*6.9	Flammability rating of materials			Pass
6.10	Intercell connector performance			Pass
6.11	Discharge capacity			Pass
6.12	Charge retention during storage			Pass
6.13	Float service with daily discharges			Pass
6.14	Recharge behaviour			Pass
6.15	Service life at an operating temperature of 40℃			Pass
6.16	Impact of a stress temperature of 55℃or 60℃			Pass
6.17	Abusive over-discharge			Pass
6.18	Thermal runaway sensitivity			Pass
6.19	Low temperature sensitivity			Pass
6.20	Dimensional stability at elevated internal pressure and temperature			Pass
6.21	Stability against mechanical abuse of units during installation			Pass

The product complies with the standard requirements of IEC 60896-21:2004&IEC 60896-22:2004.

Chapter numbers with * added are not within the scope of CNAS qualification.

General remark:

Possible test conditions:	
——The test case does not apply to the test product:	N/A
——The test sample meets the requirements:	P(ass)
——The test sample does not meet the requirements:	F(ail)

2、Sample information(s)

The following information of sample(s) was/were submitted and identified by applicant:

Product name	Lead-acid battery
Test model	LPG12-240
Additional model	LPG12-17, LPG12-100, LPFG12-150, LPG12-26, LPG12-110, LPFG12-180, LPG12-31, LPG12-125, LPCG12-24, LPG12-38, LPG12-140, LPCG12-24P, LPG12-45, LPG12-200, LPCG12-30, LPG12-50, LPCG12-40, LPG12-60, LPFG12-70, LPCG12-45, LPG12-65, LPFG12-100L, LPCG12-60, LPG12-70H, LPFG12-100, LPCG12-70, LPG12-85, LPFG12-100H, LPG12-160, LPG12-24, LPG12-55, LPG12-60, LPG12-75, LPG12-90, LPG12-130, LPG12-170, LPG12-215, LPG12-210
Trade Name	LEOCH
Nominal voltage	12 V
Rated capacity	240 Ah(10HR)
Manufacturer	Leoch International Technology Limited
Address	5th Floor, Xinbaohui Bldg., Nanhai Blvd., Nanshan, Shenzhen, China.

General remark:

This test report shall not be reproduced except in full without the written approved of the testing laboratory.

The test result presented in this report relate only to the item tested.

"(See remark#)" refers to a remark appended to the report.

"(See appended table)" refer to a table appended to the report.

3、Detection of clause

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
4	Functional requirements		P
4.1	Overview		P
	In this part of IEC 60896 the following characteristics are deemed essential to comprehensively assure the ability of stationary lead-acid batteries of the valve regulated type to perform their intended function as a reliable source of emergency power.		P
	This part of IEC 60896 is not to be used to determine the test conditions as these are defined in IEC 60896-22.		P
	The characteristics are grouped into safe operation, performance and durability needs.		P
4.2	Safe operation characteristics		P
	These tests (see Table 1) define essential safe operation properties and features of stationary lead-acid batteries of the valve regulated type.		P
4.3	Performance characteristics		P
	These tests (see Table 2) define performance properties of stationary lead-acid batteries of the valve regulated type.		P
4.4	Durability characteristics		P
	These tests (see Table 3) define essential durability properties of stationary lead-acid batteries of the valve regulated type.		P
4.5	Test requirements		P
	The test methods required to verify the characteristics defined in 6.1 to 6.21, are stated		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	and maintained in the separate standard IEC 60896-22.		
	A stationary lead-acid battery of the VRLA type covered by this present standard will be thus considered as "Tested according to IEC 60896-21 and compliant to defined requirements of IEC 60896-22".		P
	The results for safe operation characteristics will stated be reported on a "pass" or "report/state the value" basis.		P
	The requirements for performance and/or drability characteristics, defined in IEC 60896-22, will depend not only on the general category of intended use of the stationary lead-acid battery (telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications)) but also on the particular environmental and operational condition within each application.		P
5	Test set-up		P
5.1	Accuracy of measuring instruments		P
5.1.1	Voltage measurements		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 10000Ω/V.		P
5.1.2	Current measurements		P
	The instruments used shall be of an accuracy class 0,5 or better where required.		P
5.1.3	Temperature measurement		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	The instruments used shall have a resolution of 1 K. The absolute accuracy of the instruments shall be 1 K or better where required.		P
5.1.4	Time measurements		P
	The time measurements shall have of an accuracy of ±1 % or better where required.		P
5.1.5	Length measurements		P
	The instruments used shall have an accuracy of ± 0,1 % or better where required.		P
5.1.6	Weight measurements		P
	The instruments used shall have an accuracy of ±1% or better where required.		P
5.1.7	Gas volume measurements		P
	The instruments used shall have an accuracy of ±5 % or better where required.		P
5.1.8	Gas pressure measurements		P
	The instruments used shall have an accuracy of ±10 % or better where required.		P
5.2	Selection of test units		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 follows:		P
	a) Step 1: The product range(s) in a manufacturer's stationary lead-acid batteries, valve regulated types product portfolio shall be clearly and unequivocally defined by using the description as specified in 3.29.		P
	b) Step 2: From within this product range a representative cell or monobloc battery model		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	shall be selected such that this model has the most critical features regarding the outcom of the greatest number of tests. The same model within a product range shall then be subjected to all tests to qualify the entire product range. Exception shall be made for the test of 6.2, where the unit with the highest current per terminal, and the test of 6.3, where information for each cell and monobloc battery of the product range shall be reported. The documents reporting the test result shall mention the manufacturing location of the tested cells and monobloc batteries.		
	c) Step 3:The model thus defined shall be declared as the representative of the concerned product range		P
	d) Step 4: The test units (identical samples of the representative model) shall be produced in accordance with the manufacturer's standard quality procedures and marked with "60896-21 Test unit" and a unique "identification number" with indelible, handwritten and distinctive numbers of at least 30mm height on the unit cover. Component samples shall be also identified with such marking as clearly as possible taking in consideration their physical dimension and the eventual interference with test procedures.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	e) Step 5:The date of production of the test units shall be reported in the relevant test documentation.		P
	f) Step 6:The selected test units shall not be stored for more than three months after electrolyte filling and the eventual storage conditions shall be exclusively those specified in the technical documentation of the product range and reported in the relevant test documentation.		P
	g) Step 7: The test units shall not be subjected to exceptional conditioning or commissioning treatments beyond or above that specified in the relevant technical documentation of the product range. These treatments shall be reported in the relevant test documentation. Such non-authorized exceptional conditioning treatments are, for example, charge/discharge cycling, high temperature storage and similar procedures. When a manufacturer's normal practice is to dispatch units with an actual capacity Ca of less than 0,95 C_{rt}. then it is acceptable that the units are treated per a documented procedure so as to bring them up to an actual capacity Ca of at least 0,95 C_{rt} or C_{rt} as required prior to the test start. These treatments shall be reported in relevant test documentations and shall be uniform throughout all the tests.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
5.3	General test features and rules		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.		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.		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.		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.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
5.3.5	Each test and test set-up shall be documented with photographs that give a clear image of the test units and their identification numbers.		P
5.4	Number of test units		P
5.4.1	The number of units to be tested is summarized below (see Tables 4, 5 and 6).		P
5.5	Suggested test sequence		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		P
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.		P
	For an acceptance or commissioning capacity test, a discharge at the 3 h rate to a final voltage of 1,70 Vdc or as agreed upon between battery supplier and battery user, shall be selected.		P
6	Test methods		P
6.1	Gas emission		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.1.1	The test shall be carried out with six cells or three monobloc batteries.		P
6.1.2	The test units shall be selected and prepared according to 5.2.		P
6.1.3	The test units shall be tested connected in series and maintained during the test between 20℃and 25℃ (temperature of test unit). The units shall be fitted with an individual or common gas collection device so that the emitted gas can be collected from all cells over several days and its volume determined with the required accuracy.		P
6.1.4	The gas collection shall be carried out, for example, with a volumetric measurement or gas collection device similar to that shown in Figure 1. Careful attention shall be paid to ensure leak-free gas transport from the test units to the collection device during long unattended operation. The maximum hydrostatic head (as given by the difference in collection vessel immersion depth and water level) shall be not more than 20 mm.		P
6.1.5	The test units shall have, before starting the test, an actual capacity Ca of at least Crt (3 h rate – Ufinal 1.7Vpc at the selected reference temperature),be fully charged and then float charged, in a series string, for (72±0.1) h with the manufacturer's specified float voltage of $n*U_{n0}$ ± 0.01 Vpc. This voltage shall be recorded and reported. All units shall be checked for absence of leaks before commencing the test.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.1.6	After (72±0.1) h of float charge, the gas collection shall commence and the collection of gas be continued for four periods each of (168±0.1) h duration.		P
6.1.7	The cumulative total gas volume (Va in ml) collected over each of the four periods of (168± 0.1) h shall be recorded together with the ambient temperature Ta (in K} and the ambient pressure Pa (in kPa) at which each determination of the gas volumes was made.		P
6.1.8	The corrected volume of gas Vn emitted at the reference temperature of 293 K (20℃) or 298 K (25℃) and the reference pressure of 101.3 kPa, shall be calculated by the formula (ignoring correction for water vapour pressure)		P
	$V_n = \frac{V_a \times T_r}{T_a} \times \frac{p_a}{P_r}$ in ml where Va is the cumulative total gas collected of all cells in ml; Tr is the reference temperature in K (at 293 K or 298 K); Ta is the ambient temperature (in K) = 273 + Ta (in ℃); Pa is the ambient atmospheric pressure in kPa; Pr is the reference pressure of 101.3 kPa.		P
6.1.9	The normalized gas emission Ge per cell at float charge voltage conditions shall be calculated for each of the four (168±0.1) h periods with the		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	formula below:		
	$G_e = \frac{V_n}{n \times 168 \times C_{rt}}$ in ml per cell, hour and Ah (rated C3) where Vn is the total corrected gas volume emitted per test unit in ml n is the number of cells from which the gas was collected in the collection vessel 168 is the number of hours during which the gas was collected Crt is the rated C3 capacity in Ah of the test units from which the gas was collected.		P
	The normalized gas emission Ge per cell at float charge voltage conditions during each of the four periods of (168±0.1) h of the test shall be reported.		P
6.1.10	The charge voltage of the same test unit string shall then be increased to n × 2.40 Vpc±0.01 Vpc		P
6.1.11	After 24 h±0.1 h of charge at n × 2.40 Vpc ± 0.01 Vpc the gas collection shall commence and the collection of gas be continued for one period of 48 h±0.1 h duration or until 1 000 ml have been collected. In this case the time t_c (in hours) to collect 1 000 ml shall also be reported.		P
6.1.12	The cumulative total gas volume (Va in ml) collected over one period of 48 h±0.1 h shall be		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	recorded together with the ambient temperature Ta (in K) and the ambient pressure Pa (in kPa) at which the determination of the gas volumes was made. If the collection has been stopped at time t_c after accumulation of 1 000 ml, the volume after 48 h shall be determined by a simple calculation Va = (1 000 ml/ t_c) ×48 in ml.		
6.1.13	The corrected volume of gas Vn emitted at the reference temperature of 293 K (20℃) or 298 K (25℃) and the reference pressure of 101.3 kPa shall be calculated by the formula (ignoring correction for water vapour pressure)		P
	$V_n = \frac{V_a \times T_r}{T_a} \times \frac{P_a}{P_r}$ in ml Where Va: is the cumulative total gas collected of all cells in ml; Tr: is the reference temperature in K (at 293 K or 298 K); Ta: is the ambient temperature (in K) = 273 + Ta (in 。C); Pa: is the ambient atmospheric pressure in kPa; Pr: is the reference pressure of 101,3 kPa.		P
6.1.14	The normalized gas emission Ge per cell at elevated charge voltage (2.40Vpc) conditions shall be calculated for the 48 h±0.1 h period using the formula below:		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	Ge=Vn/(n×48×Cr1) in ml per cell, hour and Ah (rated C3) Where Vn: is the corrected gas volume emitted per test unit in ml n: is the number of cells from which the gas was collected in the collection vessel 48: is the number of hours during which the gas was collected Crt: is the rated C3 capacity in Ah of the test units from which the gas was collected. The normalized gas emission Ge at elevated charge voltage (2.40 Vpc) conditions during the 48 h±0.1h of the test shall be reported.	U_{flo}=2.25V(Ah/h/Cell) 1#:Ge=0.0016ml/h/Ah 2#:Ge=0.0015ml/h/Ah 3#:Ge=0.0011ml/h/Ah Vn=2.40Vpc 1#:Ge=0.0041ml/h/Ah 2#:Ge=0.0046ml/h/Ah 3#:Ge=0.0056ml/h/Ah	P
6.2	High current tolerance		P
6.2.1	The test shall be carried out with three cells or three monobloc batteries.		P
6.2.2	The test units shall be selected and prepared according to 5.2.		P
6.2.3	The test units shall have, before starting the test, an actual capacity Ca of at least $C_{rl.}$ (3 h rate - U_{final} 1.70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20℃ and 25℃		P
6.2.4	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 Vpc at 20℃or 25℃) or with a current equal to the maximum allowable discharge current, both as specified by the manufacturer in		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	the relevant technical documentation of the product range.		
6.2.5	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
6.2.6	The test units shall be examined, after the discharge, internally and externally for effects of high current flow and signs of melting. The conditions of all three units shall be reported and documented photographically.	It has no any damage after 30s of high current flow. Voltage after open circuit for 5min: 1#: U=12.33V 2#: U=12.42V 3#: U=12.41V	P
6.3	Short-circuit current and d.c. internal resistance		P
6.3.1	The test shall be carried out with three cells or three monobloc batteries.		P
6.3.2	The test units shall be selected and prepared according to 5.2.		P
6.3.3	The test units shall have, before starting the test, an actual capacity Ca of at least $C_{rt.}$ (3 h rate – U_{final} 1.70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20℃ and 25℃.		P
6.3.4	The voltage of the test units shall be measured at the terminals of each test unit in order to make sure that no external voltage drop interferes with the test result. A suitable circuit is given in Figure 2.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.3.5	The short circuit current shall be defined by determining two data pairs in the following way:		P
	a) First data pair (Ua, Ia)		P
	After 20 s of discharge at the current Ia = 4 * 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
	b) Second data pairs (Ub, Ib)		P
	After 5 s of discharge at the current Ib = 20 ×I_{10}, the voltage and current shall be recorded to give the second data pair.		P
6.3.6	The characteristics U = f(I) shall be linearly extrapolated from the two data pairs to U = 0. The intercept indicates the short-circuit current I_{sc}. The internal resistance R_i can be also determined by interpolation from these two data pairs. The appropriate formulas for this interpolation are:		P
	Short circuit current I_{sc} = $[(U_a*I_b)-(U_b*I_a)]/(U_a-U_b)$ in amperes		P
	Internal resistance $R_i=(U_a-U_b)/(I_b-I_a)$ in ohms		P
	The individual value of I_{sc} and R_i of all cells and monobloc batteries of the product range shall be reported.	1#:Isc=3455A Ri =2.06mΩ 2#:Isc=4122A Ri =2.08mΩ 3#:Isc=4322A Ri =2.06mΩ	P
6.4	Protection against internal ignition from external spark sources		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.4.1	The test (see Table 7) shall be carried out with three fully functional valve assemblies of the concerned cells or monobloc batteries of the product range.		P
	This valve assembly may be a single valve system (screw-in type) or a valve system integrated in the cell or monobloc battery cover.		P
	In both cases all design relevant features (flame barriers, seal lines and similar) shall be present in the valve assembly to be tested.		P
6.4.2	The test shall be carried out under the guidance of the safety procedures described in IEC 61430 (1997).		P
6.4.3	The test shall be carried out according to IEC 61430 Clause 4.2 using a test fixture as shown in Figure 3 and placed in an explosion test chamber shown in Figure 2 of IEC 61430. The test shall be carried out at an ambient temperature between 15℃ and 30℃.		P
6.4.4	The three functional valve assemblies shall be mounted together onto the test fixture as shown below and be documented photographically in the test report.		P
6.4.5	The test shall be carried out according to the following procedures and subclauses of IEC 61430.		P
6.4.6	The outcome of the test shall be reported and, for the purposes of IEC 60896-21 IEC 60896-22, the valve assembly is deemed to have passed the test	1#~3#: No rapid combustion, No explosion	P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	when no explosion rapid combustion event occurred within the test fixture.	Conformity	
6.5	Protection against ground short propensity		P
6.5.1	The test shall be carried out with one cell or monobloc battery.		P
6.5.2	The test unit shall be selected and prepared according to 5.2.		P
6.5.3	The test unit shall have, before starting the test, an actual capacity Ca of at least 0,95 C_{rt} (3 h rate - U_{final} 1.70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20℃ and 25℃.		P
6.5.4	The case to cover seal line of the unit shall be placed in contact with a metallic surface. This contact can be achieved, for example, by taping a conducting aluminium foil strip onto the seal line. The injection moulding points at the cell or monobloc battery case bottom can be additional site of ground short propensity and shall be investigated if needed.		P
6.5.5	The unit shall be placed horizontally (see Figure 4) and sequentially on all four possible faces according to the time schedule in 6.5.8 and 6.5.9 and float charged, with U_{flo} as specified by the manufacturer, at a room temperature between 20℃ and 25℃.		P
6.5.6	The units shall be connected, to a circuit which applies a d.c. voltage of at least 500 V±5 V between one terminal and the metallic surface		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	(aluminium foil strip) in contact with the seal line. A suggested test circuit is shown in Figure 5 below.		
6.5.7	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.		P
6.5.8	The unit shall be placed horizontally first on face 1 for 30 days or until either electrolyte leakage (with PH paper, d.c ohmmeters or similar or significant ground short current flow (few mA of current) is detected.		P
6.5.9	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 (with pH paper, d.c. ohmmeters or similar) or significant ground short current flow (few mA of current) is detected.		P
6.5.10	The presence or absence of ground short/leakage phenomena shall be reported.	1#~3#: No ground short, No leakage Conformity	P
6.6	content and durability of required markings		P
6.6.1	The test shall be carried out on three of the required markings in their definitive size, form, material and execution. Required markings may be printed, painted or moulded on the case or cover or included in a label affixed to the case or cover.		P
6.6.2	The test shall consist of visual verification of a) the presence and b) the legibility of all the		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	required markings before and after exposure to selected chemicals.		
6.6.3	The durability of the marking shall be tested, consistent with 1.7.13 of IEC 60950-1, as follows: Test with water and aliphatic solvent.		P
	The procedure is as follows:		P
	A label or marking shall be 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.		P
	The petroleum spirit used for this test shall be n-hexane (C6H14 - alkane C6) with an initial boiling point of 65℃, a dry point of approximately 69℃, a density of 0.7 kg/L and a maximum aromatic hydrocarbon content of 0.1% per volume.		P
	Test with neutralizina solutions		P
	The procedure is as follows:		P
	A new label or marking shall be rubbed for 15 s with a piece of cloth soaked with a saturated solution of sodium carbonate (Na2C03) or bicarbonate (NaHC03) in water, dried in air and then inspected visually.		P
	Test with electrolyte		P
	The procedure is as follows:		P
	A new label or marking shall be rubbed for 15 s with a piece of cloth soaked with a solution of 40% in weight of H2S04 in water, washed with water, dried in air and then inspected visually.		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
6.6.4	Each required label or marking shall be visually inspected, fully described and depicted photographically before and after the application of the test chemical.	1#~3#: Information remain readable after test and content meet requirement(see table 6.6)	P
6.7	Material identification		P
6.7.1	The inspection shall be carried out with one cell or monobloc battery cover or case having all the specified information applied in its definitive size, form, material and execution.		P
	If the case material differs from the cover material so as to justify another symbol, the inspection shall be carried out on both the case and the cover.		P
6.7.2	The specified information for material identification shall be selected from the list of abbreviation published in ISO 1043-1		P
6.7.3	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.		P
6.7.4	The stability of the marking shall be tested, if needed, with the test outlined in 6.6.	1#~3#: All the symbol remain readable; ABS plastic	P
6.8	Valve operation		P
6.8.1	The test shall be carried out with the units destined for the test 6.16 (impact of a stress temperature of 55℃ or 60℃).		P
6.8.2	The units shall be tested for valve opening before		P

IEC 60896-21:2004			
Clause	Requirement + Test	Result - Remark	Verdict
	and at the end of the stress temperature impact test at 55℃ or 60℃ as follows.		
	a) The units shall be fully charged and at a temperature between 18℃ to 27℃. b) The units shall be overcharged with a constant voltage between 2.60 Vpc to 2.70 Vpc for at least 1 h. c) A gas collection cover shall be placed sequentially onto each valve opening in such a way that all gas released from that valve is captured. d) If the valve openings are hidden by, or integrated in a gas collection cover or manifold, gas flowing from the outlet of this cover or manifold shall be collected. e) A tubing shall carry the gas from this collection cover to the bubble detection device such as for example an U-shaped glass tubing of about 15 mm diameter and with the bottom of the U filled with water. See also Figure 6. f) The opening of each valve, at a test temperature of 18℃ to 27℃ shall be verified visually by detecting the released gas bubbling through the liquid at the bottom of the U-shaped glass tubing.		P
6.8.3	The observed valve opening (adequate opening or otherwise) before and after the test of 6.16 shall be reported.	1#~3#: Gas release had been detected before and after stress temperature	P

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Clause	Requirement + Test	Result - Remark	Verdict
		impact test.	
6.9	Flammability rating of materials		P
6.9.1	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.		P
6.9.2	The test shall be carried out by an appropriate test laboratory.		P
6.9.3	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.		P
6.9.4	The test result and the resulting flammability classification of the material shall appear on a dated and signed test certificate.	1#: The flammability rating level for samples of thickness equivalent to that of case and cover: V-0	P
6.10	Intercell connector performance		P
6.10.1	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 Vpc) 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℃ and 25℃.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.10.2	The shape, size and construction details and the maximum temperature reached of the intercell connectors during this discharge test shall be reported.	The maximum temperature: 46.0°C	P
6.11	Discharge capacity		P
6.11.1	The test shall be carried out with five times six cells or five times six monobloc batteries.		P
6.11.2	The test units shall be selected and prepared according to 5.2.		P
6.11.3	The test for the actual capacity Ca, at the moment of dispatch, shall be carried out at each of the following discharge rates each time with six fully charged units. These units shall not have been previously submitted to any discharge.		P
	The capacities shall be determined with the following rates to the following end-of-discharge voltages:		P
6.11.4	The test shall be carried out with the units fully charged and with each unit temperature between 18℃ and 27℃ measured immediately prior the discharge.		P
	This initial temperature θ of the unit shall be used for the correction of its capacity in function of temperature.		P
6.11.5	The discharge shall be started within 1 h to 24 h after termination of charge and with the discharge current /dis held constant within 1% throughout the whole discharge duration.		P
6.11.6	The voltage measured at the terminals, including		P

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Clause	Requirement + Test	Result - Remark	Verdict
	one intercell connector length, of all the units shall be either recorded automatically against time or by taking the readings manually with a voltmeter. In the latter case readings shall be made at least at 25 %, 50% and 80 % of the calculated discharge time with:		
	$t=C_{rt}/I_{rt}$ (h)		P
	and then at suitable time intervals, which permits the detection of the transition to the final discharge voltage U_{final}.		P
6.11.7	In a type test for the determination of the actual capacity Ca at the moment of dispatch with five discharge rates (this subclause), the discharge shall be terminated when the following value has been recorded from each unit:		P
6.11.8	The six individual capacity data, normalized to 20℃ and 25℃ for each of the five discharge rates shall be reported.		P
6.11.9	In the type test for determination of the actual capacity Ca preceding or following a particular test routine, the discharge shall be terminated, if not specified otherwise, when the elapsed time of discharge t_{disch} of each unit with n cells to a final voltage of U_{final} = n x U_{final}(V) has been recorded.		P
6.11.10	In an acceptance or commissioning test the discharge, at one rate only, shall be terminated when one of the following values t_{disch}, whichever comes first, has been recorded:		P
6.11.11	The measured capacity Ca (Ah) at the initial		P

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Clause	Requirement + Test	Result - Remark	Verdict
	temperature θ shall be calculated as the product of the discharge current (A) and t_{disch} i.e. the discharge time (h).		
6.11.12	If the initial temperature θ is different from the reference temperature of either 20℃ or 25℃, the measured capacity shall be corrected by means of the following equation to obtain the actual capacity Ca at the selected reference temperature:	See the Annex 6.11	P
6.12	Charge retention during storage		P
6.12.1	The test shall be carried out with six cells or six monobloc batteries.		P
6.12.2	The test units shall be selected and prepared according to 5.2.		P
6.12.3	The test units shall have, before starting the test, an actual capacity Ca of at least Crt		P
6.12.4	The units shall be stored at an ambient temperature of 25℃±5K and fully disconnected from any external circuit.		P
6.12.5	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 Vpc at the selected reference temperature) can be determined.		P
6.12.6	The charge retention factor C_{rf} shall be expressed as percentage, and is equal to		P
6.12.7	The six individual values of Cr shall be reported	1#C_{rf}=85.5%; 2#C_{rf}=92.1%; 3#C_{rf}=89.9%;	P

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Clause	Requirement + Test	Result - Remark	Verdict
		4#C_{rf}=92.5%; 5#C_{rf}=86.6%; 6#C_{rf}=99.9%	
6.13	Float service with daily discharges		P
6.13.1	The test shall be carried out with six cells or three monobloc batteries.		P
6.13.2	The test units shall be selected and prepared according to 5.2.		P
6.13.3	The test units shall have, before starting the test, an actual capacity Ca of at least 0,95 C_{rt} (3 h - U_{final} 1.70 Vpc at the selected reference temperature) and be fully charged.		P
6.13.4	The units shall be connected to a device whereby they undergo a series of discharge and charge cycles. In case of test equipment voltage limitations, 2 V or 4 V units can be grouped together in series to form a larger voltage string. However the number of individual cycle performance data points should be kept constant.		P
	Each cycle shall comprise:		P
	a) A discharge for 2 h with a current of I = 2.0 I_{10} maintained constant within ±1% where I_{10} = [C10] / [10] in A and followed immediately by. b) A charge for 22 h with a current limited to I = 2.0 /10 and a voltage limited to the float voltage specified by the manufacturer for either 20℃or 25℃.		P
	c) The cells and monobloc batteries shall be operated at a temperature between 18℃ and		P

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Clause	Requirement + Test	Result - Remark	Verdict
	27℃ and the discharge-charge cycle routine a) and b) continued until, during a discharge of step a), a voltage of U_{final} 1,80 Vpc × n cells per string is reached in a time shorter than 2 h. d) The unit or string voltages and number of cycles achieved with the discharge-charge cycle routine a) and b) shall be recorded. e) The units having reached the conditions outlined in c) shall then be subjected for 168 h ±0.1 h to a charge with a current limited to I = 2.0 /10 and a voltage limited to the float voltage specified by the manufacturer for either 20℃ or 25℃. f) At the end of the 168 h±0.1 h of charge, the units shall be subjected to a capacity test with a constant current of I = 13 to U_{final} 1.70 Vpc and the capacity C_{af} corrected to 20℃ or 25℃ and recorded. This value C_{af} represents the residual capacity available when units, after numerous cycles, are then subjected to a prolonged period of charge with a charge voltage equivalent to the float voltage.		
	g) At the conclusion of the capacity test outlined in f), the units shall be fully charged and then subjected to an equalization or boost charge according to the manufacturer's specifications. At the conclusion of this equalization or boost charge treatment the units shall be subjected to a capacity test with a constant current of I = I_3		P

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Clause	Requirement + Test	Result - Remark	Verdict
	to U_{final} 1.70 Vpc and the capacity C_{ab} corrected to 20℃ or 25℃ and recorded. This value C_{ab} represents the residual capacity available when the units, after numerous cycles and a prolonged charge with float voltage setting, are subjected to a manufacturer specific equalization or boost charge treatment.		
	The test sequence a) to g) shall be repeated until, in the steps f) and g), the test units show a capacity C_{af} and C_{ab} lower than 80 % of C_{rt} (3 h rate to U_{final} 1.70 Vpc at the selected reference temperature).		P
6.13.5	The test results:		P
	a) Number of cycles achieved by each unit before reaching 1.80 Vpc during the 2h of discharge		P
	b) Capacity C_{af} expressed in % of C_{rt} after 168 h float charge		P
	c) Capacity C_{ab} expressed in % of C_{rt} after the manufacturer's specified boost charge treatment		P
	The number or routines a) to g) (of 6.13.4) achieved by each unit before either C_{af} or C_{ab} showed a residual capacity of less than 80 % of C_{rt} shall be reported as the individual value of a), b), c) and d) of each unit tested and as shown (see Tables 9 and 10 below).	1#~6#: Discharge and charge cycles:400 C_{af}=84.5%Crt C_{ab}=85.0%Crt (at least 3h-U_{final})	P
6.14	Recharge behaviour		P
6.14.1	The test shall be carried out with three cells or three monobloc batteries in a single string.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.14.2	The test units shall be selected and prepared according to 5.2.		P
6.14.3	The test units shall have, before starting the test, an actual capacity C_a of at least C_{rt} (10 h - U_{final} 1.80 Vpc at the selected reference temperature) and be fully charged.		P
6.14.4	The string shall be discharged, with unit temperature between 18℃ to 27℃, and a constant current of I= I_{10} to a string voltage U_{final} n x 1.80 Vpc. This capacity C_3 value shall be corrected to 20℃ or 25℃.		P
6.14.5	After the discharge and a 1 h±0.1 h stand in the discharged state, the units shall be recharged, with unit temperature between 18℃ to 27℃, with a current limited to I= 2.0I_{10} and a voltage limited to the float voltage specified by the manufacturer for either 20℃ or 25 ℃		P
6.14.6	After 24 h ± 0.1 h of charge the units shall be immediately discharged again with a current of I_{10} to a string voltage U_{final}, n× 1.80 Vpc. This capacity value C_{a24} shall be corrected to 20℃ or 25℃.		P
6.14.7	The capacity found after 24 h of charge C_{a24} shall be expressed as percentage of the initial actual capacity (recharge behaviour factor R_{bf}) as follows:		P
	The units shall be fully recharged and then again discharged, with unit temperature between 18℃		P

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Clause	Requirement + Test	Result - Remark	Verdict
	to 27℃and a constant current of I = I_{10} to a string voltage of n × 1.80 Vpc. This capacity C_a value shall be corrected to 20℃ or 25℃.		
6.14.9	After the discharge and a 1 h±0.1 h stand in the discharged state, the units shall be recharged 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℃or 25℃.		P
6.14.10	After 168 h±0.1 h of charge the units shall be discharged again with a current of I_{10} to a string voltage of U_{final} n×1.80 Vpc. This capacity value C_{a168} shall be corrected to 20℃or 25℃.	1#: $R_{bf24\ h}$ =95.4% $R_{bf168\ h}$ =102.1% 2#: $R_{bf24\ h}$ =95.6% $R_{bf168\ h}$ =98.8% 3#: $R_{bf24\ h}$ =97.8% $R_{bf168\ h}$ =101.1%	P
6.14.11	The capacity found after 168 h C_{a168} shall be expressed as percentage of the initial actual capacity charge (recharge behaviour factor R_{bt}) as follows:		
6.14.12	The value of $R_{bt24\ h}$ and $R_{bt168\ h}$ of the string shall be reported.		
6.15	Service life at an operating temperature of 40℃		P
6.15.1	The test shall be carried out with three cells or three monobloc batteries.		P
6.15.2	The test units shall be selected and prepared according to 5.2.		P
6.15.3	The test units shall have, before starting the test, an actual capacity Ca of at least 0.95C_{rt}(3h-Ufinal 1,70 Vpc at the selected reference temperature) and be fully charged.		P
6.15.4	The units shall be float charged at 40℃with the		P

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Clause	Requirement + Test	Result - Remark	Verdict
	manufacturer's recommended float voltage for 25℃		
6.15.5	The units shall not be outfitted with means of dimensional stabilization beyond that normally present in the cell or monobloc battery assembly and shown/specified in the appropriate technical documentation of the product range.		P
6.15.6	The units shall be placed in a hot air enclosure with such an air temperature that the monobloc batteries have a temperature of 40℃±2 K. The relative humidity level of the air of the chamber shall lower than 35% and its actual value reported.		P
6.15.7	Every 118 days±3 days the units shall, after cooling down to room temperature under float charge voltage setting, be subjected within 24 h ± 12 h to a determination of their individual actual capacity C_a (C_{rt} 3 h -final 1.70 Vpc at the selected reference temperature).		P
	The individual capacity values Ca shall be plotted in a graph as function of days elapsed at 40℃±2 K.	T=614 Days	P
6.16	Impact of a stress temperature of 55℃ or 60℃		P
6.16.1	The test shall be carried out with three cells or three monobloc batteries.		P
6.16.2	The test units shall be selected and prepared according to 5.2.		P
6.16.3	The test units shall have, before starting the test, an actual capacity Ca of at least 0.95C		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.16.4	The units shall be float charged at 55℃or 60℃ with the manufacturer recommended float voltage for 25 °C.		P
6.16.5	The units can be outfitted with means of dimensional stabilization beyond that normally present in the cell or monobloc battery assembly and shown/specified in the appropriate technical documentation of the product range. These means shall be described/shown in the test report of the product range.		P
6.16.6	The units shall be placed in a hot air enclosure with such an air temperature that the monobloc batteries have a temperature of 55℃±2 K or 60℃ ±2 K. The relative humidity level of the air of the chamber shall be lower than 35 % and its actual value reported.		P
6.16.7	When tested at 55℃, the units shall be cooled down, every 42 days±3 days, to room temperature under float charge setting and subjected, within 24h±12h, to a determination of their individual actual capacity C_a (at the 3 h rate to U_{final} 1.70 Vpc and/or at the 0.25 h rate to U_{final} 1.60 Vpc at the selected reference temperature).		P
	When tested at 60℃, the units shall be cooled down, every 30 days±3 days, to room temperature under float charge and subjected, within 24 h±12 h, to a determination of their individual actual capacity Ca (at the 3 h rate to U_{final} 1.70 Vpc		P

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Clause	Requirement + Test	Result - Remark	Verdict
	and/or at the 0.25 h rate to U_{final} 1.60 Vpc at the selected reference temperature).		
	Discharges at the 0.25 h rate are useful to evaluate the impact of the temperature on performance under UPS discharge rate conditions.		P
	No charge with voltages beyond the float charge voltage is admissible before or after such a capacity determination. After capacity determinations, the units are returned to float charge in the hot air enclosure as in 6.16.6 for another 42 days at 55℃ (or 30 days at 60℃). The test is terminated for a unit when the individual actual capacity of that unit is less than 0,8Crt. at the 3 h and/or the 0,25 h rate The remaining units continue to be tested until the actual capacity of each unit is less than 0.8Crt.		P
6.16.8	The individual capacity values Ca at the 3 h rate and/or the 0,25 h rate shall be plotted in a graph as function of days elapsed at 55℃±2 K or 60℃±2 K.	3# 3h Rate discharge test at 60℃, duration exposure time: 210 Days	P
6.17	Abusive over-discharge		P
6.17.1	The test shall be carried out with the number of units shown below.		P
6.17.2	The test units shall be selected and prepared according to 5.2.		P
6.17.3	The test units shall have, before starting the test, an actual capacity C_a of at least C_{rt}, (3 h - U_{final} 1.70 Vpc at the selected reference temperature) and be fully charged.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.17.4	The unbalanced string over-discharge test shall be carried out with four fully charged cells or monobloc batteries.		P
6.17.5	One of the 4 units shall be discharged, at a unit temperature of 18℃ to 27℃, 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
6.17.6	This four unit string shall then be discharged, with all unit temperatures between 18℃ to 27℃, with a current I = /10 (U_{final} 1.80 Vpc) until the voltage of the three, initially fully charged (i.e. not predischarged) units reach a total voltage of U_{final} of 3 × n × 1.70 Vpc where n is the number of cells in this substring.		P
6.17.7	After the discharge and a 24 h±0.1 h stand in the discharged state, the four unit string shall be recharged in series for 168 h±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℃ or 25℃.		P
6.17.8	At the end of the 168 h±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 = 13 to a U_{final} of 4 × n × 1.70 Vpc and the capacity Ca corrected to 20℃ or 25℃.		P

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Clause	Requirement + Test	Result - Remark	Verdict
6.17.9	The capacity C_a of the string shall be referenced to the rated capacity C_{rt} (3 h - U_{final} 1.70 Vpc at the selected reference temperature) as shown below and gives the unbalanced over-discharge C_{aod} capacity ratio. This value shall be reported.		P
6.17.10	The cvclic over-discharge test shall be carried out with three fully charged units.		P
6.17.11	The units shall be discharged individually or as a string, with all unit temperatures between 18℃to 27℃ and with a constant current of I = I_{10} to a voltage U_{final} of n x 1,25 Vpc where n is the number of cells per unit or string.		P
6.17.12	After the discharge and a 1 h ± 0.1 h stand in the discharged state, the units shall be recharged for 168 h ± 0.1h 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℃ or 25℃.		P
6.17.13	The sequence outlined above shall be repeated 5 times.		P
6.17.14	At the end of the fifth 168 h ± 0.1 h of charge, the units or the string shall be subjected to a capacity test with a constant current of I = 13 to U_{final} of n× 1.70 Vpc and the capacity C_a corrected to20℃ or 25℃.		P
6.17.15	The capacity C8 of each unit or of the string shall be referenced to the rated capacity Crt (3 h - Utinal 1, 70 Vpc at the selected reference temperature) as shown below and gives the cyclic	1#~4#: Unbalanced string over-discharge capacity C_{aod}=0.94C_{rt}(3h rate);	P

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Clause	Requirement + Test	Result - Remark	Verdict
	over-discharge C_{aoc} capacity ratio. This value(s) shall be reported	Cyclic over-discharge capacity C_{aoc}=0.96C_{rt}(3h rate);	
6.18	Thermal runaway sensitivity		P
6.18.1	The test shall be carried out with six cells or six monobloc batteries.		P
6.18.2	The test units shall be selected and prepared according to 5.2.		P
6.18.3	The test units shall have, before starting the test, an actual capacity C_a of at least C_{rt} (3 h - U_{final} 1.70 Vpc at the selected reference temperature) and be fully charged.		P
6.18.4	The units shall be assembled with the intercell connectors as specified in the appropriate technical documentation of the product range and the test configuration photographed and associated distances reported.		P
6.18.5	The ambient temperature shall be between 20℃ to 25℃ during the test and any natural airflow across the units shall be slower than 0.5 $m \cdot s^{-1}$		P
6.18.6	Temperature probes, with a resolution of 1K and allowing a continuous registration of the temperature (interval between temperature measurements ≤0.25 h), shall be installed as follows (see also Figures 7 and 8 below):		P
6.18.7	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		P

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Clause	Requirement + Test	Result - Remark	Verdict
	interval, between measurements, of ≤0.25 h.		
6.18.8	The constant charge voltage, measured at the terminals of the string, shall be set to n x 2.45 Vpc ± 0,01 Vpc throughout the test, where n is the number of cells in the string.		P
6.18.9	The elapsed time of charge to a unit temperature of 60℃±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.		P
6.18.10	The string shall then be cooled down to room temperature in open circuit condition and then utilized for the test in 6.18.11.		P
6.18.11	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 ≤0.25 h.		P
6.18.12	The constant charge voltage, measured at the terminals of the string, shall be set to n x 2,60 Vpc ± 0,01 Vpc throughout the test, where n is the number of cells in the string.		P
6.18.13	The elapsed time of charge to a temperature of unit 60℃±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.		P
6.18.14	At the conclusion of both tests the test data shall	1#:	P

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Clause	Requirement + Test	Result - Remark	Verdict
	be assembled and presented as follows:	$t_{2.45V}$(168h)=39.2℃ $t_{2.60V}$(24h)=44.0℃	
6.19	Low temperature sensitivity		P
6.19.1	The test shall be carried out with three cells or three monobloc batteries.		P
6.19.2	The test units shall be selected and prepared according to 5.2.		P
6.19.3	The test units shall have, before starting the test, an actual capacity C_a of at least C_{rt}, (3 h - U_{final} 1.70 Vpc at the selected reference temperature) and be fully charged.		P
6.19.4	The units shall be individually discharged with a current of I =I_{10} to an Ufinal of n×1.80Vpc at a unit temperature between 18℃ and 27℃.		P
6.19.5	The discharged units shall then be placed in a test chamber with a forced flow of air having a temperature of -18℃±2 K.		P
6.19.6	After 72 h ± 1 h of residence in the test chamber the units shall be withdrawn from the test chamber and, after 24 h ± 1 h of stand at open circuit, charged in a room with an ambient temperature between +18 to +27℃ for 168 h±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℃or 25℃.		P
6.19.7	The units shall then be individually discharged with a current of I =I_3 to an U_{final} of n x 1.70 Vpc and the actual capacity Ca corrected to 20℃or		P

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Clause	Requirement + Test	Result - Remark	Verdict
	25℃ shall be recorded.		
6.19.8	The capacity C_a of each unit shall be referenced to the rated capacity C_{rt}· (3 h - U_{final} 1.70 Vpc at the selected reference temperature) as shown below and gives the Cals capacity ratio.		P
6.19.9	The units shall be inspected for fractures, excessive bulging or other freezing induced damages.		P
6.19.10	The three individual values of Gals as also freezing damage shall be reported.		P
6.19.11	The sequence 6.19.1 to 6.19.10 shall be repeated with a new set of units only if the previous freeze cycle resulted in a significant capacity loss or freezing damages and be modified as shown in 6.19.12.		P
6.19.12	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 x 1.70 Vpc at a unit temperature between 18℃ and 27℃		P
6.19.13	The test data shall be reported as follows (see Table 11):	No mechanical damages C_{als}=0.98C_{rt}(3h rate)	P
6.20	Dimensional stability at elevated internal pressures and temperatures		P
6.20.1	The test shall be carried out with one cell or one monobloc battery.		P
6.20.2	The test unit, inclusive eventual standard structural stabilizing features, shall be adapted with a pressure regulator to maintain a pressure in		P

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Clause	Requirement + Test	Result - Remark	Verdict
	all interior cavities of the test unit equal to the maximum valve opening pressure present in units and as specified by the manufacturer. This value shall be measured and reported. This specified pressure shall be maintained throughout the test.		
6.20.3	The maximum outside dimension (width and length of the cell case shall be measured before pressurization and recorded.		P
6.20.4	The pressurized unit shall be placed into a chamber with recirculating air at a temperature of 50℃±2 K.		P
6.20.5	After 24 h±0.1 h of residence in the test chamber and under pressure, the maximum outside dimension (width and length) of the cell case shall be measured and recorded at temperature as close as possible to 50℃±2 K.	1#: L:0.44%+1.3mm W:0.35%+0.6mm	P
6.20.6	The increase in the cell case dimensions after 24 h ±0.1 h at 50℃±2 K shall be reported both as percentage deviation from the value before the test and as measured change in mm.		
6.21	Stability against mechanical abuse of units during installation		P
6.21.1	The test shall be carried out with two cells or two monobloc batteries.		P
6.21.2	The test unit shall be selected and prepared according to 5.2 and not have any protective packing.		P
6.21.3	The units shall be dropped according to the height prescriptions of IEC 60068-2-32 and amendment.		P

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Clause	Requirement + Test	Result - Remark	Verdict
	Two "Free Fall", for resistance against leakages caused by two drops each onto a smooth, level concrete floor from drop heights as specified below:		
6.21.4	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
6.21.5	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
6.21.6	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 detector, PH indicator paper and the like and the findings documented and reported.	2#: No leakage, No broken	P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
4	Functional requirements		P
4.1	Overview		P
	In this part of IEC 60896 the following requirements are deemed essential to comprehensively assure the ability of stationary lead-acid batteries of the valve regulated type to perform their intended function as a reliable source of emergency power.		P
	This part of IEC 60896 is not to be used to determine the test conditions as these are defined in IEC 60896-21.		P
	These requirements are grouped into safe operation, performance and durability needs.		P
4.2	Safe operation requirements		P
	These requirements (see Table 1) define essential safe operation properties and features of stationary lead-acid batteries of the valve regulated type.		P
4.3	Performance requirements		P
	These requirements (see Table 2) define performance properties of stationary lead-acid batteries of the valve regulated type.		P
4.4	Durability requirements		P
	These requirements (see Table 3) define essential durability properties of stationary lead-acid batteries of the valve regulated type.		P
4.5	Test requirements		P
	The test methods required to verify the requirements defined in 6.1 to 6.21, are stated and maintained in the separate standard IEC 60896-21.		P
	A stationary lead-acid battery of the VRLA type		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	covered by this present standard will be thus considered as "Tested according to IEC 60896-21 and compliant to defined requirements of IEC 60896-22".		
	The requirements for safe operation characteristics will stated be on a "pass" or "report/state the value" basis.		P
	The requirements for performance and/or durability characteristics will depend not only on the general category of intended use of the stationary lead-acid battery (telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications)) but also on the particular environmental and operational condition within each application.		P
5	Reporting format		P
5.1	Application related definition of appropriate performance and durability requirements		P
	The stationary lead-acid batteries of the valve regulated (VRLA) types covered by this standard are suitable for numerous applications such as telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications. Each application and each user may require, beyond a common and single set of safe operation properties, a particular and customised set of performance and durability properties of the cells and battery monoblocs.		P
	These performance and durability properties should be selected and conveyed to the battery manufacturer via Annex A of this standard.		P
	In order to select the appropriate safe operation, performance and durability requirements listed in		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	subclauses 6.1 to 6.21 below, the following step-by-step approach is suggested.		
5.2	Battery user or specifier statement of requirements (Annex A)		P
	The battery specifier shall state his requirements by completing the requirements form contained within this standard as Annex A, by taking cues from the requirements listed for a		P
	This Annex A form can then be included as part of the overall battery specification and forwarded to the battery manufacturer for his response.		P
5.3	Battery manufacturer or vend or statement of test results (Annex B)		P
	The completed form will summarize the results obtained from the tests carried out according to IEC 60896-21 on a representative product of a particular product range and making the object of the vendor response.		P
	More in-depth, subclause-by-subclause test results documentation can be requested from the supplier if needed.		P
	By obtaining statements of test results (Annex B), obtained with the same test methods and reported in the same manner, from several suppliers worldwide, a battery user will be able to evaluate how closely any proposed product range(s) matches his application and requirements as defined in his unique statement of requirements (Annex A).		P
6	Requirements and characteristics		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
6.1	Requirement for gas emission information		P
6.1.1	The purpose of this requirement (see Table 4) is the determination of gas emission volumes under normal float and overcharge voltage conditions.		P
6.1.2	The result of this test documents the amount of gas, reported as hydrogen, released during the float- and overcharge conditions.		P
	This value can be used by designers of equipment and facilities to validate if adequate air exchange exists in accordance with national or international standards for battery room ventilation.		P
6.2	Requirement for high current tolerance		P
6.2.1	The purpose of this requirement (see Table 5) is the verification that the design of the internal current conducting components is robust enough so to withstand short periods of abnormally high discharge current which may occur before current limiting devices in the exterior circuit activate (fuses etc.).		P
6.2.2	The result of this test documents the condition of the top-lead and of the terminals after 30 s of high current flow at a level below the maximum short circuit current of the tested unit.		P
6.3	Requirement for short-circuit current and d.c. internal resistance information		P
6.3.1	The purpose of this requirement (see Table 6) is to provide data about the possible used to determine the size and suitable type of safety devices such as fuses or circuit breakers. The values have an accuracy of ±10 %. The test also yields, at the same time and using the		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	same method, the internal d.c. resistance of the units.		
6.4	Requirement for protection against internal ignition from external spark sources		P
6.4.1	The purpose of this requirement (see Table 7) is to evaluate the adequacy of protective features such as the valve/flame barrier assembly as a safeguard against the ignition of gases, within the volume enclosed by the valve, from an external ignition source. The external ignition source shall be in the form of sparks generated between two auxiliary electrodes.		P
6.4.2	The results of this test documents the protection afforded by the flame barrier at the valve/flame barrier assembly when a defined hydrogen gas volume emission occurs and sparks are generated near the gas-venting opening.		P
6.5	Requirement for protection against ground short propensity		P
6.5.1	The purpose of this requirement(see Table 8) is to confirm the satisfactory resistance of the units toward phenomena enhancing ground shorts such as the occurrence of an electrolyte break-through at seals, joints or at terminals. An electrolyte break-through can be enhanced by gravity (horizontal position operation mode) and d.c. voltage gradients (electro-capillarity phenomena).		P
6.5.2	The result of this test documents if a particular operating orientation results in conductive paths of electrolyte causing ground short current flow conditions and associated fire risks.		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
6.6	Requirement for content and durability of required markings		P
6.6.1	The purpose of this requirement (see Table 9and 10) is to ensure the presence of essential product and safety information on each unit and their legibility after exposure to a set of chemicals.		P
6.6.2	The result of this test documents the presence of a minimum of information content and stability against chemicals.		P
6.7	Requirement for material identification		P
6.7.1	The purpose of this requirement (see Table 11) is to enhance the recycling of material for environmental protection by ensuring that the plastic materials used for the units are clearly identified with the ISO 1043-1 material symbol and legible throughout the service life.		P
6.7.2	The result of this test documents the presence of correct and legible material identification.		P
6.8	Requirement for the operation of the valve		P
6.8.1	The purpose of this requirement (see Table 12) is to ensure that each valve on the unit is opening and releasing gas before and after the high temperature (55℃or 60℃) stress test.		P
6.8.2	The result of this test documents that the valve of the cell will function properly as a one-way vent over the service life of the unit.		P
6.9	Requirement for definition of the flammability rating of the materials		P
6.9.1	The purpose of this requirement (see Table 13) is to ensure that the burning properties of the non-metallic		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	materials of the case/cover have been defined in accordance with international standards by completing an appropriate laboratory test.		
6.9.2	The result of this test documents the burning and self-extinguishing property levels resulting from the plastic material of the units so to plan adequate fire safety measures.		P
6.10	Requirement for performance of the intercell connector		P
6.10.1	The purpose of this requirement (see Table 14) is to show the maximum temperature reached by the specified intercell connector (the external conductor that connects individual units or monoblocs to form a battery) under the high current conditions.		P
6.10.2	The result of this test documents if a high temperature (T > 70℃) hazard exists on the connector during a high rate discharge.		P
6.11	Requirement for discharge capacity performance		P
6.11.1	The purpose of this requirement (see Table 15) is to confirm the capacity to a specific end-voltage at the selected discharge rate or rates, at the moment of unit dispatch.		P
6.11.2	The result of this test documents the level of compliance of the actual capacity with the rated capacity at the moment of dispatch of a sample of six units at five separate discharge rates.		P
6.12	Requirement for charge retention during storage		P
6.12.1	The purpose of this requirement (see Table 16) is to show the actual capacity retained after a set period of time in storage of a unit filled with electrolyte and		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	charged.		
6.12.2	The result of this test documents available capacity after a storage period of 6 months at 20 。C to 30 。C ambient air temperature and give an indication of possible recharge intervals.		P
6.13	Requirement for float service with daily discharges		P
6.13.1	The purpose of this requirement (see Table 17) is to define the aggregate capacity and cycling behaviour of the battery undergoing very frequent or even daily discharges such as experienced in areas with irregular or insufficient main supply, and where recharge can be carried out only under float voltage settings conditions.		P
6.13.2	The result of this test documents the capability of the particular battery design to operate satisfactorily for extended periods with a very limited amount of overcharge following each discharge.		P
	As such operation may result, depending on battery design, in a temporary or permanent capacity loss, the corrective effects of prolonged charge with float voltage settings and with the manufacturer's suggested equalization or boost charge condition will be also quantified.		P
6.14	Requirement for recharge behaviour		P
6.14.1	The purpose of this requirement (see Table 18) is to define the capacity once more available following a long duration discharge with both short (24 h) and long (168h) periods of recharge under float voltage settings.		P
6.14.2	The result of this test documents the effective available capacity, as a percent of the original capacity after a		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	recharge for 24 h or 168 h using only the recommended float voltage setting.		
6.15	Requirement for service life at an operating temperature of 40℃.		P
6.15.1	The purpose of this requirement (see Table 19) is to elicit standardized information about the service behavior of the units under elevated but realistic operating temperatures and float voltage settings.		P
6.15.2	The result of this test documents the evolution of capacity of units operated, without temperature related float voltage compensation, at the upper limits of a long duration service envelope. The result will give direct life expectancy data without the need of using acceleration factors.		P
6.16	Requirement for the impact of a stress temperature 。f 55℃or 60℃		P
6.16.1	The purpose of the requirement (see Table 20) is to elicit information on how long units perform under elevated temperature stress conditions. These stress conditions degrade the performance of the units very rapidly as increased water loss and grid corrosion will result in increasing capacity losses.		P
6.16.2	The result of this test documents how sensitive a particular design is towards abusive high operating temperature conditions and, if the units are operated close to such conditions which design will tolerate these conditions for longer.		P
6.17	Requirement for the impact of abusive over-discharges		P
6.17.1	The purpose of the requirement (see Table 21) is to		P

IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	abusive over-discharges during the service life, show a minimum specified conditions.		
6.17.2	The results of these tests documents the available capacity		P
	a) after a severely capacity-unbalanced string has been discharged and recharged, and b) after repetitive discharges with large active mass utilization factors to a low end of discharge voltage.		P
	Such conditions may arise when units with irregular charge levels are used as replacements of failed units in a string or where low voltage disconnects are not available or have failed.		P
6.18	Requirements for information on thermal runaway sensitivity		P
6.18.1	The purpose of the requirement (see Table 22)is to elicit standardized information about how soon units may enter thermal runaway conditions when exposed to higher than normal voltages under specified conditions.		P
6.18.2	The result of this test documents the elapsed time and the current associated before reaching elevated temperatures with standardized battery layouts. This facilitates the evaluation if a particular unit design shows increased sensitivity toward escalating temperature and current conditions.		P
6.19	Requirement for the impact of low temperature service on capacity		P
6.19.1	The purpose of this requirement (see Table 23) is to ensure that units experiencing abusive low temperature conditions during service life show a minimum of		P

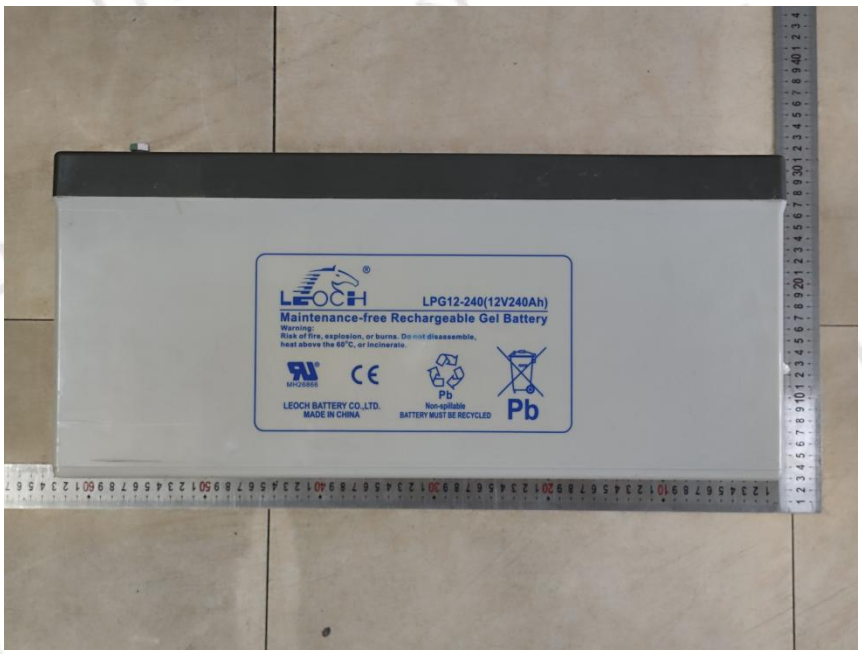
IEC 60896-22:2004			
Clause	Requirement + Test	Result - Remark	P
	mechanical stability against freezing induced forces and adequate capacity recovery under specified conditions.		
6.19.2	The result of this test documents how a particular unit design is capable of withstanding electrolyte freezing which may be encountered in installations without adequate thermal protection and mains supply stability.		P
6.20	Requirement for dimensional stability at elevated internal pressures and temperatures		P
6.20.1	The purpose of this requirement (see Table 24) is to provide an indication of the susceptibility of the unit to "balloon out" or expand under certain conditions and may be of interest where cells/monoblocs are to be installed in areas of restricted space.		P
6.20.2	The result of the test documents for the designer of battery installations the potential deformations of the units to be expected and related clearances needed.		P
6.21	Requirements for stability against mechanical abuse of units during installation		P
6.21.1	The purpose of this requirement (see Table 25) is to ensure that the unit design is mechanically robust enough to withstand standardized mechanical stresses during unpacked transport and installation.		P
6.21.2	The result of the test documents if impact forces on unit edges and corners will lead to electrolyte leakages. This test does not replace seismic or other specific vibration tests.		P

4、Test data

Table 6.6: Requested markings information to be present	
Technical information to be present	
Polarity sign at the positive terminal(s) with a + symbol radius of at least 6 mm	Conformity
Manufacturer and/or vendor name	Leoch International Technology Limited
Country of origin of unit	Made in China
Type designation of unit	LPG12-240 (12V240Ah)
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	240Ah(End voltage 1.8Vpc 25℃)
Rated temperature (20 ℃ or 25℃) for the capacity value	25℃
Float voltage in Vpc or V per unit at a rated temperature of 20 ℃ and/or 25 ℃	2.25V of 25℃
Date of manufacture (see Note 1 below) in clear unequivocal mm.yyyy format	202201
ISO warning symbols to be present with 11 mm diameter minimum size and in two contrasting colours (See Note 2 and 3 below)	
Warning	P
Electrical danger	P
No open fires and sparks	P
Wear eye protection	P
Read instructions	P
Environmental protection and recycling symbols to be present	
Recycling symbol	P
Crossed out waste bin	P
NOTE 1 For the purpose of this standard the “date of manufacture" is defined as the date of final inspection of the units in the factory of origin. NOITE 2 When the physical dimensions of the units do not allow to apply the symbols on the unit itself then as eparate label to be affixed near the battery or on the battery operating instructions is acceptable. NOTE 3 The background colour is considered to be one colour.	

Table 6.11	Discharge capacity				P	
Capacity / No.	C_{10} (Ah)	C_8 (Ah)	C_3 (Ah)	C_1 (Ah)	$C_{0.25}$ (Ah)	Remark
1#	246.5	236.5	191.5	151.2	101.5	25°C Ca≥95 %Crt
2#	241.2	237.2	194.2	154.2	102.1	
3#	249.3	238.5	196.4	158.2	104.2	
4#	240.5	233.5	198.2	159.2	105.2	
5#	241.2	234.2	199.9	158.7	106.8	
6#	241.2	233.2	198.2	150.2	101.4	

5、Sample Photo

Details of:	Fig. 1 – Front view of Battery
	

Details of:	Fig. 2 – Side view of Battery
	

Details of:	Fig. 3 – Top view of Battery
	

The sample picture is only used to inform the customer that the sample received by the laboratory is shown in the picture, which does not prove the appearance and quality of the customer's products.

End of Report

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