TEST REPORT

For

Valve Regulated Sealed Lead Arcid Battery

Model Number: **FTBI2-100II**

CE

Prepared For	:	Shandong Sacredsun Power Sources Co., Ltd No.1 Shengyang Road, Qufu City, Shangdong Province, P.R.China
Prepared By	:	Shenzhen Toby Technology Co., Ltd. 10/F., A Block, Jiada R & D Bldg., No.5 Songpingshan Road, Science & Technology Park, Nanshan District, Shenzhen, China
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Report Number	:	**TB-LVD095946**
Date of Test	:	Mar. 17-Nov. 23, 2009
Date of Report	:	Nov. 25-30, 2009

CERTIFICATION

APPLICANT----------:	Shandong Sacredsun Power Sources Co., Ltd
ADDRESS----------:	No.1 Shengyang Road, Qufu City, Shangdong Province, P.R.China
FACTORY----------:	Shandong Sacredsun Power Sources Co., Ltd
ADDRESS----------:	No.1 Shengyang Road, Qufu City, Shangdong Province, P.R.China
PRODUCT----------:	Valve Regulated Sealed Lead Arcid Battery
MODELS----------:	FTBI2-100II

Test Standards

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

The EUT described above has been tested by us with the listed standards and found in compliance with the Council Directive 2006/66/EC. It is possible to use CE marking to demonstrate the compliance with the Council Directive.

The test report is valid for above tested sample only and shall not be reproduced in part without written approval of the laboratory.

Reported by :	(Peter Hou)	Date :	Dec. 01, 2009
Checked by :	(Benny Xu)	Date :	Dec. 02-04, 2009
Approved by :	(Justin Zhang)	Date :	Dec. 07, 2009

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 laboratory----------	Shenzhen Toby Technology Co., Ltd.
Address----------	10/F., A Block, Jiada R & D Bldg., No.5 Songpingshan Road, Science & Technology Park, Nanshan District, Shenzhen, China
Testing location----------	Shenzhen Toby Technology Co., Ltd.
Applicant----------	Shandong Sacredsun Power Sources Co., Ltd
Address----------	No.1 Shengyang Road, Qufu City, Shangdong Province P.R.China
Standard----------	IEC 60896-21:2004& IEC 60896-22:2004
Test result----------	Compliance with the standards requirements.
Procedure deviation----------	N.A.
Non-standard test method---:	N.A.
Type of test object----------	Valve Regulated Sealed Lead Arcid Battery
Trademark----------	---
Models/Type reference-------:	FTBI2-100II
Rating----------	See page 5
Factory----------	Shandong Sacredsun Power Sources Co., Ltd
Address----------	No.1 Shengyang Road, Qufu City, Shangdong Province P.R.China

Test case verdicts		
Test case does not apply to the test object	:	N(.A.)
Test item does meet the requirement	:	P(ass)
Test item does not meet the requirement	:	F(ail)

General remarks:

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

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

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

3. "(see appended table)" refers to a table appended to the report.

4. This report shall not be reproduced except in full without the written approval of the Shenzhen TOBY.

Artwork of Marking Label

Shandong Sacredsun Power Sources Co., Ltd
Name: Valve Regulated Sealed Lead Arcid Battery
Model: FTBI2-100II
Rated capacity: 12V100Ah (25℃)
Float voltage: 2.28V/unit (25℃)
Date of manufacture: mm. yyyy

Made In China

NOTE: "mm. yyyy" mean that: mm=the month of manufacture, yyyy=the year of manufacture.

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
1	**Scope**		**P**
	This part of IEC 60896 applies to all stationary lead-acid cells and monobloc batteries of the valve regulated type for float charge applications, (i.e. permanently connected to a load and to a d.c. power supply), in a static location (i.e. not generally intended to be moved from place to place) and incorporated into stationary equipment or installed in battery rooms for use in telecom, uninterruptible power supply (UPS), utility switching, emergency power or similar applications.		P
4	**Functional characteristics**		**P**
4.1	In this part of IEC 60896 the following characteristics are deemed essential to comprehensively define 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
4.2	Safe operation characteristics	See 6.1-6.10	P
4.3	Performance characteristics	See 6.11-6.14	P
4.4	Durability characteristics	See 6.15-6.21	P
4.5	Test result requirements	According to Part 22	P
5	**Test set-up**		**P**
6	**Test methods**		**P**
6.1	Gas emission	(See appended table 6.1)	P
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 °C and 25 °C (temperature of test unit).	25°C	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.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.1.5	The test units shall have, before starting the test, an actual capacity Ca of at least Crt (3 h rate – Ufinal 1,70 Vpc at the selected reference temperature), be fully charged and then float charged, in a series string, for 72 h ± 0,1 h with the manufacturer's specified float voltage of n × Uflo ± 0,01 Vpc. This voltage shall be recorded and reported. All units shall be checked for absence of leaks before commencing the test.		P
6.1.6	After 72 h ± 0,1 h of float charge, the gas collection shall commence and the collection of gas be continued for four periods each of 168 h ± 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 h ± 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 °C) or 298 K (25 °C) and the reference pressure of 101,3 kPa, shall be calculated by the formula		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 h ± 0,1 h periods with the formula		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 tc (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 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.		P
6.1.13	The corrected volume of gas Vn emitted at the reference temperature of 293 K (20 °C) or 298 K (25 °C) and the reference pressure of 101,3 kPa shall be calculated by the formula		P
6.1.14	The normalized gas emission Ge per cell at elevated charge voltage (2,40 Vpc) conditions shall be calculated for the 48 h ± 0,1 h period using the formula		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.2	High current tolerance	(See appended table 6.2)	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 Crt (3h rate – Ufinal 1,70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20 °C and 25 °C.		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 Ufinal 1,80 Vpc 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
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.		P
6.3	Short-circuit current and d.c. internal resistance	(See appended table 6.3)	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 Crt (3 h rate – Ufinal 1,70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20 °C and 25 °C.		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
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
	b) Second data pairs (Ub, Ib)		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 Isc.		P
6.4	Protection against internal ignition from external spark sources (See appended table 6.4)		P
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
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 °C and 30 °C.		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 and IEC 60896-22, the valve assembly is deemed to have passed the test when no explosion or rapid combustion event occurred within the test fixture.		P
6.5	Protection against ground short propensity (See appended table 6.5)		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.		
6.5.3	The test unit shall have, before starting the test, an actual capacity Ca of at least 0,95 Crt (3 h rate – Ufinal 1,70 Vpc at the selected reference temperature), be fully charged and have unit temperature between 20 °C and 25 °C.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 Uflo as specified by the manufacturer, at a room temperature between 20 °C and 25 °C.		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 (aluminium foil strip) in contact with the seal line. A suggested test circuit is shown in Figure 5 below.		P
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.		P
6.6	Content and durability of required markings	(See appended table 6.6)	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 required markings before and after exposure to selected chemicals.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.6.3	The durability of the marking shall be tested, consistent with 1.7.13 of IEC 60950-1, as follows:		P
	Test with water and aliphatic solvent.		P
	a) 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
	b) The petroleum spirit used for this test shall be n-hexane (C6H14 – alkane C6) with an initial boiling point of 65 °C, a dry point of approximately 69 °C, a density of 0,7 kg/l and a maximum aromatic hydrocarbon content of 0,1 % per volume.		P
	Test with neutralizing solutions		P
	Test with electrolyte		P
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.		P
6.7	Material identification	(See appended table 6.7)	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
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.		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 °C or 60 °C).		P
6.8.2	The units shall be tested for valve opening before and at the end of the stress temperature impact test at 55 °C or 60 °C		P
6.8.3	The observed valve opening (adequate opening or otherwise) before and after the test of 6.16 shall be reported.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.9	Flammability rating of materials	(See appended table 6.9)	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.		P
6.10	Intercell connector performance	(See appended table 6.10)	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 °C and 25 °C.		P
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.		P
6.11	Discharge capacity	(See appended table 6.11)	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 *C*a, 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
6.11.4	The test shall be carried out with the units fully charged and with each unit temperature between 18 °C and 27 °C measured immediately prior the discharge.		P
6.11.5	The discharge shall be started within 1 h to 24 h after termination of charge and with the discharge current *I*dis held constant within 1 % throughout the whole discharge duration.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.11.6	The voltage measured at the terminals, including 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		P
6.11.7	In a type test for the determination of the actual capacity *C*a at the moment of dispatch with five discharge rates (this subclause), the discharge shall be terminated		P
6.11.8	The six individual capacity data, normalized to 20 °C and 25 °C for each of the five discharge rates shall be reported.		P
6.11.9	In the type test for determination of the actual capacity *C*a 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 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		P
6.11.11	The measured capacity *C*a (Ah) at the initial temperature . shall be calculated as the product of the discharge current (A) and *t*disch		P
6.11.12	If the initial temperature . is different from the reference temperature of either 20 °C or 25 °C, the measured capacity shall be corrected by means of the following equation to obtain the actual capacity *C*a at the selected reference temperature		P
6.12	Charge retention during storage	(See appended table 6.12)	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 *C*a of at least *C*rt (3 h rate – *U*final 1,70 Vpc at the selected reference temperature), and be fully charged.		P
6.12.4	The units shall be stored at an ambient temperature of 25 °C ± 5 K 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

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.12.6	The charge retention factor *C*rf shall be expressed as percentage		P
6.12.7	The six individual values of *C*rf shall be reported		P
6.13	Float service with daily discharges	(See appended table 6.13)	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 *C*a of at least 0,95 Crt (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.		P
6.13.5	test results:		P
	a) Number of cycles achieved by each unit before reaching 1,80 Vpc during the 2 h 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
6.14	Recharge behaviour	(See appended table 6.14)	P
6.14.1	The test shall be carried out with three cells or three monobloc batteries in a single string.		P
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 °C to 27 °C, and a constant current of *I* = *I*10 to a string voltage *U*final *n* . 1,80 Vpc. This capacity *C*a value shall be corrected to 20 °C or 25 °C.		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 °C to 27 °C, 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.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 °C or 25 °C.		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) a		P
6.14.8	The units shall be fully recharged and then again discharged, with unit temperature between 18 °C to 27 °C 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 °C or 25 °C.		P
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 °C or 25 °C.		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 °C or 25 °C.		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*bf)		P
6.14.12	The value of Rbf24 h and Rbf168 h of the string shall be reported.		P
6.15	Service life at an operating temperature of 40 °C (See appended table 6.15)		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 *C*a of at least 0,95*C*rt (3 h – *U*final 1,70 Vpc at the selected reference temperature) and be fully charged.		P
6.15.4	The units shall be float charged at 40 °C with the manufacturer's recommended float voltage for 25 °C.		P
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

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 °C ± 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 – *U*final 1,70 Vpc at the selected reference temperature).		P
6.15.8	The individual capacity values *C*a shall be plotted in a graph as function of days elapsed at 40 °C ± 2 K.		P
6.16	Impact of a stress temperature of 55 °C or 60 °C (See appended table 6.16)		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 *C*a of at least 0,95*C*rt (3 h – *U*final 1,70 Vpc and/or 0,25h – *U*final 1,60 Vpc) at the selected reference temperature) and be fully charged.		P
6.16.4	The units shall be float charged at 55 °C or 60 °C with the manufacturer's 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 °C ± 2 K or 60 °C ± 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 °C, 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

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.16.8	The individual capacity values *C*a 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 °C ± 2 K or 60 °C ± 2 K.		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
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 °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
6.17.6	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 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 °C or 25 °C.		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* = *I*3 to a *U*final of 4 . *n* . 1,70 Vpc and the capacity *C*a corrected to 20 °C or 25 °C.		P
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 cyclic over-discharge test shall be carried out with three fully charged units.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
6.17.11	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* . 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 . 0,1 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.		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* = *I*3 to *U*final of *n* . 1,70 Vpc and the capacity *C*a corrected to 20 °C or 25 °C.		P
6.17.15	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 Vpc at the selected reference temperature) as shown below and gives the cyclic over-discharge *C*aoc capacity ratio.		P
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 °C to 25 °C during the test and any natural airflow across the units shall be slower than 0,5 m.s–1.		P
6.18.6	Temperature probes, with a resolution of 1 K and allowing a continuous registration of the temperature (interval between temperature measurements ≤0,25 h), shall be installed as standard specified		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 interval, between measurements, of ≤0,25 h.		P
6.18.8	The constant charge voltage, measured at the terminals of the string, shall be set to n × 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 °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.		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 × 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 °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.		P
6.18.14	At the conclusion of both tests the test data shall be assembled and presented		P
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 Ca of at least Crt (3 h – Ufinal 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 = I10 to an Ufinal of n × 1,80 Vpc at a unit temperature between 18 °C and 27 °C.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 °C ± 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 °C 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 °C or 25 °C.		P
6.19.7	The units shall then be individually discharged with a current of *I* =*I*3 to an *U*final of *n* × 1,70 Vpc and the actual capacity *C*a corrected to 20 °C or 25 °C shall be recorded.		P
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 *C*als 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 *C*als 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* × 1,70 Vpc at a unit temperature between 18 °C and 27 °C.		P
6.19.13	The test data shall be reported		P
6.20	Dimensional stability at elevated internal pressures and temperatures (See appended table 6.20)		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 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.		P

IEC 60896-21:2004& IEC 60896-22:2004			
Clause	Requirement Test		Verdict
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 °C ± 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 a temperature as close as possible to 50 °C ± 2 K.		P
6.20.6	The increase in the cell case dimensions after 24 h ± 0,1 h at 50 °C ± 2 K shall be reported both as percentage deviation from the value before the test and as measured change in mm.		P
6.21	Stability against mechanical abuse of units during installation (See appended table 6.21)		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. Two "Free Fall", for resistance against leakages caused by two drops each onto a smooth, level concrete floor from drop heights as specified		P
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 detectors, pH indicator paper and the like and the findings documented and reported.		P

6.1	TABLE: Gas emission test		P
Ca=100Ah, Pa=101KP, Tr=298K			
condition	At 2.28V	condition	At 6.84V
1st period	55mL/cell , 168h at 25°C	48h	69mL/cell , 48h at 25°C
2nd period	57mL/cell , 168h at 25°C	Or 1000 mL	---
3rd period	56mL/cell , 168h at 25°C	---	---
4th period	62mL/cell , 168h at 25°C	---	---
Total	230mL/cell , 672h at 25°C	Total	69mL/cell , 48h at 25°C
Ca=100Ah, Pa=101KP, Tr=298K			
condition	At 2.28V	condition	At 6.84V
1st period	66mL/cell , 168h at 25°C	48h	78mL/cell , 168h at 25°C
2nd period	54mL/cell , 168h at 25°C	Or 1000 mL	---
3rd period	59mL/cell , 168h at 25°C	---	---
4th period	69mL/cell , 168h at 25°C	---	---
Total	248mL/cell , 672h at 25°C	Total	78mL/cell , 168h at 25°C
Ca=100Ah, Pa=101KP, Tr=298K			
condition	At 2.28V	condition	At 6.84V
1st period	72mL/cell , 168h at 25°C	48h	84mL/cell , 168h at 25°C
2nd period	74mL/cell , 168h at 25°C	Or 1000 mL	---
3rd period	69mL/cell , 168h at 25°C	---	---
4th period	78mL/cell , 168h at 25°C	---	---
Total	293mL/cell , 672h at 25°C	Total	84mL/cell , 168h at 25°C
NOTE: 1 period=168h.			

6.2	TABLE: High current tolerance	P
	Ca=100Ah, Idis=780A,	
After 30 s of high current flow	Electrical continuity(YES/NO)	YES
	Incipient melting (YES/NO)	NO
Stand for 5 min in open circuit after above test	Voc	1.72V
	Ca=100Ah, Idis=780A,	
After 30 s of high current flow	Electrical continuity(YES/NO)	YES
	Incipient melting (YES/NO)	NO
Stand for 5 min in open circuit after above test	Voc	1.74V
	Ca=100Ah, Idis=780A,	
After 30 s of high current flow	Electrical continuity(YES/NO)	YES
	Incipient melting (YES/NO)	NO

Stand for 5 min in open circuit after above test	Voc	1.76V

6.3	TABLE: Short circuit current and d.c. internal resistance	P
Ca=100Ah, at 25°C		
Isc (short circuit current)	2720A	
Ri(internal resistance)	4.5mΩ	

6.4	TABLE: Protection against internal ignition from external spark sources	P

6.5	TABLE: Protection against ground short propensity		P
Ca=100Ah			
Test date	Evidence of rapid combustion	explosion	PH paper
D=30 on face 1	No	No	No change
D=7 on face 2	No	No	No change
D=7 on face 3	No	No	No change
D=7 on face 4	No	No	No change
No electrolyte leakage and no evidence of t ground short.			

6.6	TABLE: Content and durability of required markings	P
Test with water and aliphatic solvent.	After this test, the marking shall be legible; it canl not be possible to remove marking plates easily and they shall show no curling.	P
Test with electrolyte	After this test, the marking shall be legible; it canl not be possible to remove marking plates easily and they shall show no curling.	P

6.7	TABLE: Material identification	P

6.9	TABLE: Flammability rating of materials		P
Glow wire test			
Part		Temperature (°C)	Verdict
Enclosure plastic		750°C	P

6.10	**TABLE: Intercell connector performance**	**P**

Maximum measured temperature T of /at::	T (°C)	Allowed Tmax (°C)
intercell connectors	57°C	74°C
Ambient	25°C	---

6.11	**TABLE: Discharge capacity**		**P**
	U(V)	I(A)	Ca/Crt
C10 (10h rate)	1.80	10A	97.7%
C8 (8h rate)	1.75	11.7A	97.9%
C3 (3h rate)	1.70	28.1A	98.6%
C1 (1h rate)	1.60	69.8A	99.0%
C0,25 (0.25h rate)	1.60	197A	98.4%

6.12	**TABLE: Charge retention during storage**	**P**

Sample	Cast	Crf = (Cast × 100) / Ca
C1	84	84%
C2	81	81%
C3	76	76%
C4	83	83%
C5	79	79%
C6	80	80%

6.13	**TABLE: Float service with daily discharges**		**P**
Sample 1			
	Number of 2h discharge cycles to 1.80Vpc	Capacity available (Caf)	Capacity available (Cab)
Reliable mains power	17	89%	90%
Unreliable mains power	---	---	---
Very Unreliable mains power	---	---	---
Sample 2			
	Number of 2h discharge cycles to 1.80Vpc	Capacity available (Caf)	Capacity available (Cab)

Reliable mains power	15	88%	90%
Unreliable mains power	---	---	---
Very Unreliable mains power	---	---	---
Sample 3			
	Number of 2h discharge cycles to 1.80Vpc	Capacity available (Caf)	Capacity available (Cab)
Reliable mains power	15	90%	91%
Unreliable mains power	---	---	---
Very Unreliable mains power	---	---	---

6.14	TABLE: Recharge behaviour	P
Sample 1		
Rbf24h	94.1%	
Rbf168 h	100%	
Sample 2		
Rbf24h	92.6%	
Rbf168 h	100%	
Sample 3		
Rbf24h	93.8%	
Rbf168 h	100%	

6.15	TABLE: Service life at an operating temperature of 40 °C			P
condition	Sample 1	Sample 2	Sample 3	
Brlef duration exposure time	---	---	---	---
Medium duration exposure time	750<D<1000	750<D<1000	750<D<1000	---
Long duration exposure time	---	---	---	---
Very long duration exposure time	---	---	---	---

6.16	TABLE: Impact of a stress temperature of 55 °C or 60 °C			P
	At 55 °C		At 60 °C	
Brlef duration exposure time	3h rate dis	0.25h rate dis	3h rate dis	0.25h rate dis

Medium duration exposure time	---	---	---	---
Long duration exposure time	290 Days	170Days	268 Days	152Days
Very long duration exposure time	---	---	---	---
relative humidity=(30±2)%				

6.20	TABLE: Dimensional stability at elevated internal pressure and temperature		P
NO.	T(chamber)	Dimensional change(Length)	Dimensional change(Width)
C1	50°C	<0.01%	<0.01%
After 24 hours latter			
NO.	T(chamber)	Dimensional change(Length)	Dimensional change(Width)
C1	50°C	<0.01%	<0.01%

6.21	TABLE: Stability against mechanical abuse of units during installation		P
	Weight	Height	Dielectric breakdown test
Sample1	33.2	288	No breakdown
Sample2	33.2	288	No breakdown

PHOTOS

Photo 1 of EUT

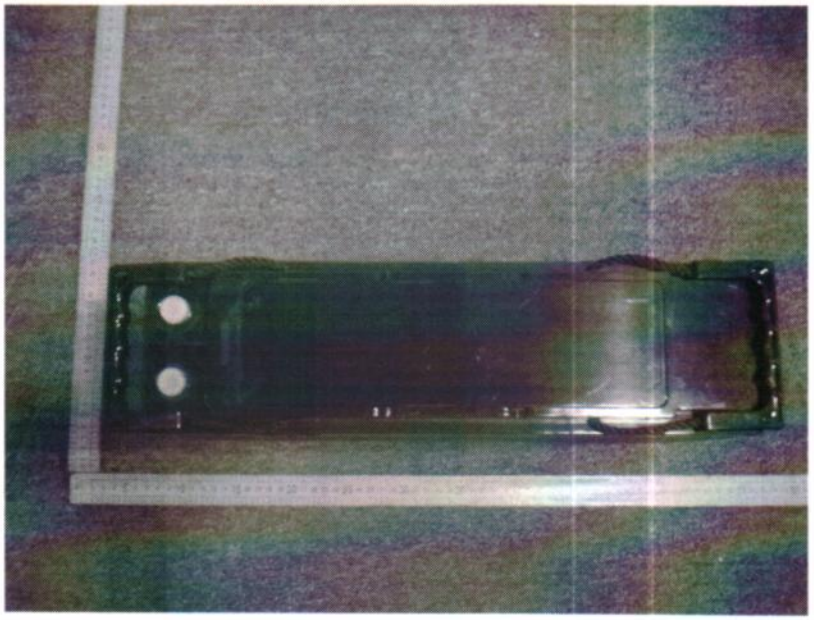


Photo 2 of EUT

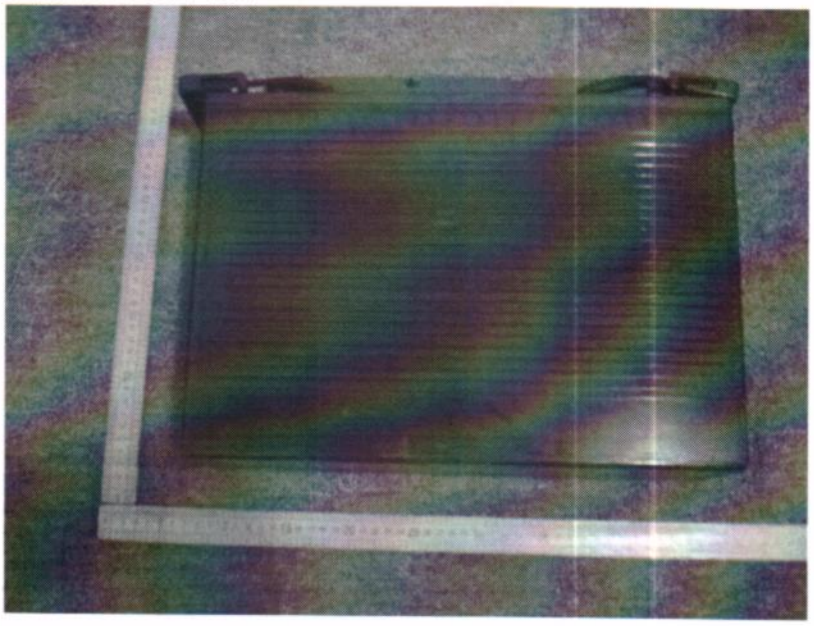


Photo 3 of EUT

Photo 4 of EUT

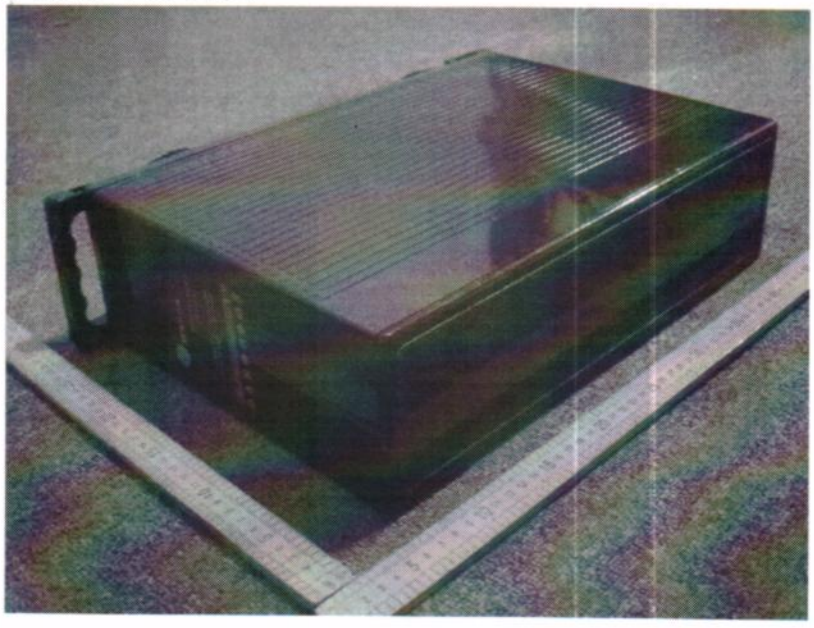
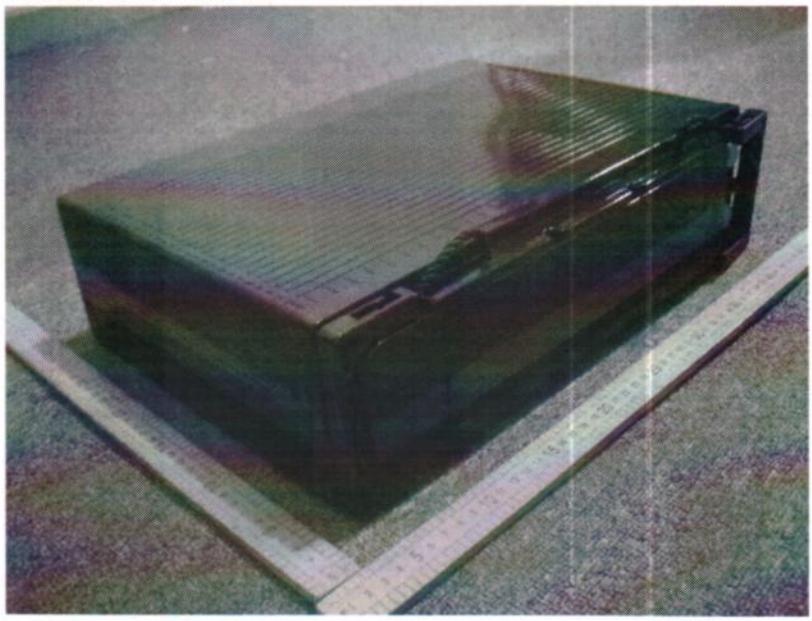


Photo 5 of EUT



END OF REPORT