



TEST REPORT
IEC 60086-4
Primary batteries
Part 4: Safety of lithium batteries

Report Number SHES230300481301

Date of issue..... 2023-04-11

Total number of pages 17 Pages

Applicant's name..... Suzhou Xinlvzhou Electronics Co., Ltd.

Address No.158 Shanji Road, Xiangcheng District, Suzhou, Jiangsu, China

Test specification:

Standard IEC 60086-4: 2019 (Fifth Edition)

Test procedure Commission testing according to the requirements of Applicant.

Non-standard test method..... N/A

Test Report Form No..... EEC_IEC 60086_4 A

Test Report Form(s) Originator SGS-CSTC

Master TRF..... Dated 2021-01

Test item description WARRIORS CR2450 BATTERY

Trade Mark warriors

Manufacturer Same as applicant

Model/Type reference CR2450

Ratings Rated voltage: 3,0 V



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Testing procedure and testing location:		
☒	Testing Laboratory:	SGS-CSTC Standards Technical (Shanghai) Services Co., Ltd.
Testing location/ address		588 West Jindu Road, Xinqiao, Songjiang, 201612 Shanghai, China
Tested by (name + signature)		JJ Yang / Project Engineer 
Approved by (name + signature)		Bruce Wu / Project Reviewer 
☐	Testing procedure: TMP	N/A
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature)		
☐	Testing procedure: WMT	N/A
Testing location/ address		
Tested by (name + signature)		
Witnessed by (name + signature)		
Approved by (name + signature)		
☐	Testing procedure: SMT	N/A
Testing location/ address		
Tested by (name + signature)		
Approved by (name + signature)		
Supervised by (name + signature)		



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List of Attachments: Attachment 1: Photos.	
Summary of testing: The sample(s) tested complies with the requirements of IEC 60086-4: 2019 and EN IEC 60086-4:2019. No decision rule is specified by standard, when comparing the measurement result with the applicable limit according to the specification in that standard. The decisions on conformity are made without applying the measurement uncertainty. ("simple acceptance" decision rule, previously known as "accuracy method") Remark: Cell was considered and tested according to standard in this report.	
Tests performed (name of test and test clause): ☒ 6.4.1 Altitude ☒ 6.4.2 Thermal cycling ☒ 6.4.3 Vibration ☒ 6.4.4 Shock ☒ 6.5.1 External short-circuit ☒ 6.5.2 Impact ☐ 6.5.3 Crush ☒ 6.5.4 Forced discharge ☒ 6.5.5 Abnormal charging ☒ 6.5.6 Free fall ☒ 6.5.7 Thermal abuse ☐ 6.5.8 Incorrect installation ☐ 6.5.9 Overdischarge	Testing location: SGS-CSTC Standards Technical Services (Shanghai) Co., Ltd. 588 West Jindu Road, Xinqiao Songjiang, 201612 Shanghai, China
Summary of compliance with National Differences List of countries addressed: none. ☒ The product fulfils the requirements of EN IEC 60086-4:2019.	



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Copy of marking plate



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Test item particulars.....: --	
Classification of installation and use: --	
Supply Connection.....: --	
Possible test case verdicts: - test case does not apply to the test object: N/A - test object does meet the requirement: P (Pass) - test object does not meet the requirement: F (Fail)	
Testing:	
Date of receipt of test item.....: 2023-03-20	
Date (s) of performance of tests.....: 2023-03-24 to 2023-04-07	
General remarks: The test results presented in this report relate only to the object tested. This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory. "(see Enclosure #)" refers to additional information appended to the report. "(see appended table)" refers to a table appended to the report. Throughout this report a ☒ comma / ☐ point is used as the decimal separator. This document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at http://www.sgs.com/en/Terms-and-Conditions.aspx and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Document.aspx . Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.	
Manufacturer's Declaration:	
The application for obtaining a Test Certificate includes more than one factory location and a declaration from the Manufacturer stating that the sample(s) submitted for evaluation is (are) representative of the products from each factory has been provided:	☐ Yes ☒ Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies): Same as applicant	



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General product information:

Product description:	WARRIORS CR2450 BATTERY
Model:	CR2450
Rated voltage:	3,0 V
Rated capacity	600 mAh
Abnormal charge current:	15 mA
Max. continuous discharge current:	15 mA



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IEC 60086-4			
Clause	Requirement + Test	Result - Remark	Verdict
4	Requirements for safety		P
4.1	Design consideration		P
	a) Abnormal temperature rise above the critical value		P
	b) Control of temperature increases in the battery		P
	c) Lithium cells and batteries shall be designed to relieve excessive internal pressure or to preclude a violent rupture under conditions of transport, intended use and reasonably foreseeable misuse.	Seal the seam around the aluminium case as the venting mechanism.	P
4.2	Quality plan		P
	The manufacturer shall prepare a quality plan defining the procedures for the inspection of materials, components, cells and batteries during the course of manufacture, to be applied to the total process of producing a specific type of battery.	Quality plan was provided.	P
5	Sampling		P
5.1	General		P
5.2	Test samples		P
6	Testing and requirements		P
6.1	General		P
6.1.1	Test application		P
	s: cell or single cell battery	Single cell battery	P
	m: multi cell battery	--	N/A
6.1.3	Ambient temperature	20 °C ± 5 °C	P
6.1.4	Parameter measurement tolerances		P
6.1.5	Predischarge		P
6.1.6	Additional cells		P
6.2	Evaluation of test criteria		P
6.2.1	Short-circuit		P
6.2.2	Excessive temperature rise		P
6.2.3	Leakage		P



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IEC 60086-4			
Clause	Requirement + Test	Result - Remark	Verdict
6.2.4	Mass loss		P
6.2.5	Venting		P
6.2.6	Fire		P
6.2.7	Rupture		P
6.2.8	Explosion		P
6.3	Tests and requirements – Overview		P
6.4	Tests for intended use See the standard		P
6.4.1	Test A: Altitude	See Table 6.4.1	P
6.4.2	Test B: Thermal cycling	See Table 6.4.2	P
6.4.3	Test C: Vibration	See Table 6.4.3	P
6.4.4	Test D: Shock	See Table 6.4.4	P
6.5	Tests for reasonably foreseeable misuse		P
6.5.1	Test E: External short-circuit	See Table 6.5.1	P
6.5.2	Test F: Impact	See Table 6.5.2	P
6.5.3	Test G: Crush	See Table 6.5.3	N/A
6.5.4	Test H: Forced discharge	See Table 6.5.4 $C_r=600\text{ mAh}$, $I_i=15\text{ mA}$	P
6.5.5	Test I: Abnormal charging	See Table 6.5.5 $C_n=600\text{ mAh}$, $I_c=15\text{ mA}$	P
6.5.6	Test J: Free fall	See Table 6.5.6	P
6.5.7	Test K: Thermal abuse	See Table 6.5.7	P
6.5.8	Test L: Incorrect installation	See Table 6.5.8	N/A
6.5.9	Test M: Overdischarge	See Table 6.5.9	N/A
6.6	Information to be given in the relevant specification		P
	a) Predischage current specified by the manufacturer	The predischage current is 15 mA.	P
	b) Declaration whether the impact test or the crush test is more appropriate to simulate an internal short-circuit condition	Impact test	P



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IEC 60086-4			
Clause	Requirement + Test	Result - Remark	Verdict
	c) Maximum continuous discharge current specified by the manufacturer for test H;: NOTE 1 Forced discharge of a cell can occur when it is connected in series with other cells and when it is not protected with a bypass diode. Where applicable, this should be reflected by the specification. and	The maximum continuous discharge current is 15 mA.	P
	d) Abnormal charging current declared by the manufacturer for test I: NOTE 2 Abnormal charging of a cell can occur when it is connected in series with other cells and one cell is reversed or when it is connected in parallel with a power supply and the protective devices do not operate correctly. Where applicable, this should be reflected by the specification.	The abnormal charging current is 15 mA.	P
7	Information for safety		P
7.1	Safety precautions during design of equipment		N/A
7.1.1	Charge protection		N/A
7.1.2	Parallel connection		N/A
7.2	Safety precautions during handling of batteries		P
7.3	Packaging		P
7.4	Handling of battery cartons		P
7.5	Transport		P
7.5.1	General		P
7.5.2	Air transport		P
7.5.3	Sea transport		P
7.5.4	Land transport		P
7.6	Display and storage		P
7.7	Disposal		P
8	Instructions for use		P
9	Marking		P
9.1	General		P
9.2	Swallowable batteries		P
9.3	Safety pictograms		P



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IEC 60086-4					
Clause	Requirement + Test			Result - Remark	Verdict
	TABLE 1 and 6.4.1 – 6.5.3				P
Tests A-E	Cells and single cell batteries	Undischarged	10	Tests A-D: NL, NV, NC, NR, NE, NF Test E: NT, NR, NE, NF	P
		Fully discharged	10	Tests A-D: NL, NV, NC, NR, NE, NF Test E: NT, NR, NE, NF	P
	Multi-cell batteries	Undischarged	4		N/A
		Fully discharged	4		N/A
Test F or G	Cells and single cell batteries	Undischarged	5	Tests F: NT, NE, NF	P
		Fully discharged	5	Tests F: NT, NE, NF	P
	Multi-cell batteries	Undischarged	5 component cells		N/A
		Fully discharged	5 component cells		N/A
Test H	Cells and single cell batteries	Fully discharged	10	NE, NF	P
	Multi-cell batteries	Fully discharged	10		N/A
Test I to K	Cells and single cell batteries	Undischarged	5	Test I: NE, NF Test J: NV, NE, NF Test K: NE, NF	P
	Multi-cell batteries	Undischarged	5		N/A
Test L	Cells and single cell batteries	Undischarged	20 (Four batteries connected in series with one of the four batteries reversed (5 sets).)		N/A



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Clause	Requirement + Test			Result - Remark	Verdict
Test M	Cells and single cell batteries	50 % predischarged	20 (Four batteries connected in series, one of which is 50 % predischarged (5 sets).)		N/A
		75 % predischarged	20 (Four batteries connected in series, one of which is 75 % predischarged (5 sets).)		N/A



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Test A		TABLE6.4.1 Altitude			
Sample No.	Sample Status ¹⁾	OCV/V Before Test	OCV/V After Test	Residual OCV /%	Result
C1	1	3,377	3,377	100,00	P
C2	1	3,375	3,375	100,00	P
C3	1	3,378	3,378	100,00	P
C4	1	3,378	3,378	100,00	P
C5	1	3,375	3,375	100,00	P
C6	1	3,370	3,370	100,00	P
C7	1	3,374	3,374	100,00	P
C8	1	3,373	3,373	100,00	P
C9	1	3,376	3,376	100,00	P
C10	1	3,376	3,376	100,00	P
C11	2	2,466	2,466	100,00	P
C12	2	2,462	2,462	100,00	P
C13	2	2,461	2,461	100,00	P
C14	2	2,452	2,452	100,00	P
C15	2	2,447	2,447	100,00	P
C16	2	2,468	2,468	100,00	P
C17	2	2,462	2,462	100,00	P
C18	2	2,458	2,458	100,00	P
C19	2	2,456	2,456	100,00	P
C20	2	2,463	2,463	100,00	P

Remark:
1- Undischarged;
2- Fully discharged.
No leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.

Test B		TABLE6.4.2 Thermal cycling			
Sample No.	Sample Status ¹⁾	OCV/V Before Test	OCV/V After Test	Residual OCV /%	Result
C1	1	3,377	3,372	99,85	P
C2	1	3,375	3,368	99,79	P
C3	1	3,378	3,373	99,85	P
C4	1	3,378	3,373	99,85	P
C5	1	3,375	3,370	99,85	P
C6	1	3,370	3,370	100,00	P
C7	1	3,374	3,370	99,88	P
C8	1	3,373	3,365	99,76	P
C9	1	3,376	3,370	99,82	P
C10	1	3,376	3,370	99,82	P
C11	2	2,466	2,466	100,00	P
C12	2	2,462	2,462	100,00	P
C13	2	2,461	2,461	100,00	P
C14	2	2,452	2,452	100,00	P
C15	2	2,447	2,447	100,00	P
C16	2	2,468	2,468	100,00	P
C17	2	2,462	2,462	100,00	P
C18	2	2,458	2,458	100,00	P
C19	2	2,456	2,456	100,00	P



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C20	2	2,463	2,463	100,00	P
Remark: 1- Undischarged; 2- Fully discharged. No leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.					

Test C	TABLE6.4.3 Vibration				
Sample No.	Sample Status ¹⁾	OCV/V Before Test	OCV/V After Test	Residual OCV /%	Result
C1	1	3,372	3,370	99,94	P
C2	1	3,368	3,368	100,00	P
C3	1	3,373	3,370	99,91	P
C4	1	3,373	3,371	99,94	P
C5	1	3,370	3,368	99,94	P
C6	1	3,370	3,368	99,94	P
C7	1	3,370	3,368	99,94	P
C8	1	3,365	3,365	100,00	P
C9	1	3,370	3,368	99,94	P
C10	1	3,370	3,370	100,00	P
C11	2	2,466	2,466	100,00	P
C12	2	2,462	2,462	100,00	P
C13	2	2,461	2,461	100,00	P
C14	2	2,452	2,452	100,00	P
C15	2	2,447	2,447	100,00	P
C16	2	2,468	2,468	100,00	P
C17	2	2,462	2,462	100,00	P
C18	2	2,458	2,458	100,00	P
C19	2	2,456	2,456	100,00	P
C20	2	2,463	2,463	100,00	P
Remark: 1- Undischarged; 2- Fully discharged. No leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.					

Test D	TABLE6.4.4 Shock				
Sample No.	Sample Status ¹⁾	OCV/V Before Test	OCV/V After Test	Residual OCV /%	Result
C1	1	3,370	3,370	100,00	P
C2	1	3,368	3,368	100,00	P
C3	1	3,370	3,370	100,00	P
C4	1	3,371	3,371	100,00	P
C5	1	3,368	3,368	100,00	P
C6	1	3,368	3,368	100,00	P
C7	1	3,368	3,368	100,00	P
C8	1	3,365	3,365	100,00	P
C9	1	3,368	3,368	100,00	P
C10	1	3,370	3,370	100,00	P
C11	2	2,466	2,466	100,00	P
C12	2	2,462	2,462	100,00	P
C13	2	2,461	2,461	100,00	P
C14	2	2,452	2,452	100,00	P



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C15	2	2,447	2,447	100,00	P
C16	2	2,468	2,468	100,00	P
C17	2	2,462	2,462	100,00	P
C18	2	2,458	2,458	100,00	P
C19	2	2,456	2,456	100,00	P
C20	2	2,463	2,463	100,00	P

Remark:

1- Undischarged;

2- Fully discharged.

No leakage, no venting, no short-circuit, no rupture, no explosion and no fire during this test.

Test E	TABLE6.5.1 External Short Circuit Test					P
Sample No.	Sample Status ¹⁾	Ambient (55°C ± 5°C)	OCV at start of test, Vdc	Resistance of Circuit, Ω	Maximum Case Temperature, °C	Results
C1	1	50,5	3,370	0,082	8,5	P
C2	1	50,5	3,368	0,082	10,3	P
C3	1	50,5	3,370	0,089	10,3	P
C4	1	50,5	3,371	0,084	7,5	P
C5	1	50,5	3,368	0,082	7,8	P
C6	1	50,5	3,368	0,082	8,9	P
C7	1	50,5	3,368	0,082	9,8	P
C8	1	50,5	3,365	0,089	10,8	P
C9	1	50,5	3,368	0,084	6,9	P
C10	1	50,5	3,370	0,082	8,1	P
C11	2	50,8	2,466	0,082	2,3	P
C12	2	50,8	2,462	0,082	0,4	P
C13	2	50,8	2,461	0,089	0,7	P
C14	2	50,8	2,452	0,084	0,1	P
C15	2	50,8	2,447	0,082	0,9	P
C16	2	50,8	2,468	0,082	1,2	P
C17	2	50,8	2,462	0,082	0,6	P
C18	2	50,8	2,458	0,089	0,8	P
C19	2	50,8	2,456	0,084	0,4	P
C20	2	50,8	2,463	0,082	0,6	P

Requirements:

There shall be no excessive temperature rise, no rupture, no explosion and no fire during this test and within the 6 h of observation.

1- Undischarged;

2- Fully discharged.

Test F	TABLE6.5.2 Impact				P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Maximum Case Temperature Rise ΔT, °C	Results
C21	1	20,9	3,376	0,9	P
C22	1	20,9	3,373	0,7	P
C23	1	20,9	3,369	0,5	P



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C24	1	20,9	3,364	1,0	P
C25	1	20,9	3,366	0,8	P
C26	2	20,9	2,457	0,8	P
C27	2	20,9	2,568	0,7	P
C28	2	20,9	2,555	0,5	P
C29	2	20,9	2,563	0,2	P
C30	2	20,9	2,498	0,4	P

Requirements:

There shall be no excessive temperature rise, no explosion and no fire during this test and within the 6 h of observation.

- 1- Undischarged;
- 2- Fully discharged.

Test G	TABLE6.5.3 Crush				N/A
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Maximum Case Temperature, °C	Results
--	--	--	--	--	--
--	--	--	--	--	--

Test H	TABLE6.5.4 Forced discharged			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C31	2	22,9	2,673	P
C32	2	22,9	2,542	P
C33	2	22,9	2,627	P
C34	2	22,9	2,483	P
C35	2	22,9	2,622	P
C36	2	22,9	2,648	P
C37	2	22,9	2,536	P
C38	2	22,9	2,542	P
C39	2	22,9	2,489	P
C40	2	22,9	2,536	P

Requirements:

There shall be no explosion and no fire during this test and within 7 days after the test.

- 1- Undischarged;
- 2- Fully discharged.

Test I	TABLE6.5.5 Abnormal charging			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C41	1	22,8	3,364	P
C42	1	22,8	3,368	P
C43	1	22,8	3,362	P
C44	1	22,8	3,362	P
C45	1	22,8	3,487	P

Requirements:


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There shall be no explosion and no fire during this test.

- 1- Undischarged;
- 2- Fully discharged.

Test J	TABLE6.5.6 Free fall			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C41	1	23,2	3,364	P
C42	1	23,2	3,368	P
C43	1	23,2	3,362	P
C44	1	23,2	3,362	P
C45	1	23,2	3,487	P

Requirements:

There shall be no venting, no explosion and no fire during this test and within the 1 h of observation.

- 1- Undischarged;
- 2- Fully discharged.

Test K	TABLE6.5.7 Thermal abuse			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C41	1	24,1	3,364	P
C42	1	24,1	3,368	P
C43	1	24,1	3,362	P
C44	1	24,1	3,362	P
C45	1	24,1	3,487	P

Requirements:

There shall be no explosion and no fire during this test.

- 1- Undischarged;
- 2- Fully discharged.

Test L	TABLE6.5.8 Incorrect installation			N/A
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
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Test M	TABLE6.5.9 Overdischarged			N/A
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
--	--	--	--	--
--	--	--	--	--



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