



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

Report Number : SHES240200272901

Date of issue..... : 2024-03-28

Total number of pages : 16 Pages

Applicant's name..... : SUZHOU XINLVZHOU ELECTRONICS CO., LTD.

Address : SHANJI ROAD 158, XIANGCHENG DISTRICT, SUZHOU CITY,
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 : Primary Battery

Trade Mark : WARRIORS

Manufacturer : Same as applicant

Model/Type reference : CR1616 LITHIUM CELL

Ratings : Rated Voltage: 3,0 V

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)		Brian Han / Project Engineer <i>Brian Han</i>
Approved by (name + signature)		Bruce Wu / Project Reviewer <i>Bruce Wu</i>
☐	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) ..		

List of Attachments: Attachment 1: Photos.	
Summary of testing: Test were arranged according to 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: 1. The samples were subjected to full tests as far as applicable.	
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 Over discharge	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.	

Copy of marking plate



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..... : 2024-02-21 Date (s) of performance of tests..... : 2024-02-21 to 2024-03-19													
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													
General product information: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tr> <td style="width: 50%;">Product description:</td> <td>Primary Battery</td> </tr> <tr> <td>Model:</td> <td>CR1616 LITHIUM CELL</td> </tr> <tr> <td>Rated voltage:</td> <td>3,0 V</td> </tr> <tr> <td>Rated capacity</td> <td>50 mAh</td> </tr> <tr> <td>Abnormal charge current:</td> <td>1 mA</td> </tr> <tr> <td>Max. continuous discharge current:</td> <td>10 mA</td> </tr> </table>		Product description:	Primary Battery	Model:	CR1616 LITHIUM CELL	Rated voltage:	3,0 V	Rated capacity	50 mAh	Abnormal charge current:	1 mA	Max. continuous discharge current:	10 mA
Product description:	Primary Battery												
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Rated voltage:	3,0 V												
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Max. continuous discharge current:	10 mA												

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		--
	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.		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
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

IEC 60086-4			
Clause	Requirement + Test	Result - Remark	Verdict
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	--	N/A
6.5.3	Test G: Crush	See Table 1 and 6.4.1 – 6.5.3	P
6.5.4	Test H: Forced discharge	See Table 1 and 6.4.1 – 6.5.3 $C_r=50 \text{ mAh}$, $I_r=10 \text{ mA}$	P
6.5.5	Test I: Abnormal charging	See Table 1 and 6.4.1 – 6.5.3 $C_n=50 \text{ mAh}$, $I_c=1 \text{ mA}$	P
6.5.6	Test J: Free fall	See Table 1 and 6.4.1 – 6.5.3	P
6.5.7	Test K: Thermal abuse	See Table 1 and 6.4.1 – 6.5.3	P
6.5.8	Test L: Incorrect installation	See Table 1 and 6.4.1 – 6.5.3	P
6.5.9	Test M: Overdischarge	See Table 1 and 6.4.1 – 6.5.3	P
6.6	Information to be given in the relevant specification		P
	a) PredischARGE current specified by the manufacturer	The predischARGE current is 10 mA	P
	b) Declaration whether the impact test or the crush test is more appropriate to simulate an internal short-circuit condition	Crush test	P
	c) Maximum continuous discharge current specified by the manufacturer for test H;	The maximum continuous discharge current is 10 mA	P
	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 d) Abnormal charging current declared by the manufacturer for test I	The abnormal charging current is 1 mA	P
7	Information for safety		P
	7.1 Safety precautions during design of equipment		N/A

IEC 60086-4			
Clause	Requirement + Test	Result - Remark	Verdict
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	Small batteries		P

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 (10 samples to be tested)	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 (4 samples to be tested)	Undischarged	4		N/A
		Fully discharged	4		N/A
Test F or G	Cells and single cell batteries	Undischarged	5 (Button and cylindrical) 10 (Prismatic)	Button: NT, NE, NF	P
		Fully discharged	5 (Button and cylindrical) 10 (Prismatic)	Button: NT, NE, NF	P
	Multi cell batteries	Undischarged	No Battery tests required but the component cells shall have passed the test		N/A
		Fully discharged			N/A
Test H	Cells and single cell batteries	Undischarged	N/A		N/A
		Fully discharged	10	NE, NF	P
	Multi cell batteries	Undischarged	No Battery tests required but the component cells shall have passed the test		N/A
		Fully discharged			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
		Fully discharged	N/A		N/A
	Multi cell batteries	Undischarged	5		N/A
		Fully discharged	N/A		N/A
Test L	Cells and single cell batteries	Undischarged	5 (+15)		N/A
		Fully discharged	N/A		N/A

IEC 60086-4					
Clause	Requirement + Test		Result - Remark		Verdict
Test M	Multi cell batteries	Undischarged	N/A		N/A
		Fully discharged	N/A		N/A
	Cells and single cell batteries	Undischarged	50% predischarged		N/A
		Fully discharged	75% predischarged		N/A
	Multi cell batteries	Undischarged	N/A		N/A
		Fully discharged	N/A		N/A

Test A	TABLE6.4.1 Altitude				
Sample No.	Sample Status ¹⁾	OCV/V Before Test	OCV/V After Test	Residual OCV /%	Result
C1	1	3,368	3,367	99,97	P
C2	1	3,333	3,333	100,00	P
C3	1	3,338	3,336	100,00	P
C4	1	3,344	3,344	100,00	P
C5	1	3,349	3,348	99,97	P
C6	1	3,339	3,339	100,00	P
C7	1	3,330	3,330	100,00	P
C8	1	3,334	3,334	100,00	P
C9	1	3,349	3,349	100,00	P
C10	1	3,335	3,335	100,00	P
C11	2	2,884	2,884	100,00	P
C12	2	2,901	2,901	100,00	P
C13	2	2,894	2,894	100,00	P
C14	2	2,894	2,894	100,00	P
C15	2	2,902	2,902	100,00	P
C16	2	2,903	2,903	100,00	P
C17	2	2,899	2,899	100,00	P
C18	2	2,902	2,902	100,00	P
C19	2	2,906	2,906	100,00	P
C20	2	2,898	2,898	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	3,367	3,362	99,86	P
C2	1	3,333	3,324	99,74	P
C3	1	3,338	3,332	99,82	P
C4	1	3,344	3,337	99,80	P
C5	1	3,348	3,340	99,75	P
C6	1	3,339	3,340	99,85	P
C7	1	3,330	3,323	99,78	P
C8	1	3,334	3,326	99,77	P
C9	1	3,349	3,342	99,79	P
C10	1	3,335	3,329	99,81	P
C11	2	2,884	2,881	99,88	P
C12	2	2,901	2,898	99,90	P
C13	2	2,894	2,893	99,95	P
C14	2	2,894	2,894	100,00	P
C15	2	2,902	2,900	99,92	P
C16	2	2,903	2,900	99,89	P
C17	2	2,899	2,898	99,96	P
C18	2	2,902	2,902	100,00	P
C19	2	2,906	2,905	99,96	P
C20	2	2,898	2,898	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	3,362	3,361	99,97	P
C2	1	3,324	3,324	100,00	P
C3	1	3,332	3,331	99,97	P
C4	1	3,337	3,336	99,97	P
C5	1	3,340	3,339	99,97	P
C6	1	3,334	3,334	100,00	P
C7	1	3,323	3,322	99,97	P
C8	1	3,326	3,325	99,97	P
C9	1	3,342	3,341	99,97	P
C10	1	3,329	3,328	99,97	P
C11	2	2,881	2,880	99,97	P
C12	2	2,898	2,897	99,97	P
C13	2	2,893	2,893	100,00	P
C14	2	2,894	2,894	100,00	P
C15	2	2,900	2,899	99,97	P
C16	2	2,900	2,900	100,00	P
C17	2	2,898	2,897	99,97	P
C18	2	2,902	2,901	99,97	P
C19	2	2,8905	2,905	100,00	P
C20	2	2,898	2,898	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	3,361	3,361	100,00	P
C2	1	3,324	3,324	100,00	P
C3	1	3,331	3,331	100,00	P
C4	1	3,336	3,336	100,00	P
C5	1	3,339	3,339	100,00	P
C6	1	3,334	3,334	100,00	P
C7	1	3,322	3,322	100,00	P
C8	1	3,325	3,325	100,00	P
C9	1	3,341	3,341	100,00	P
C10	1	3,328	3,328	100,00	P
C11	2	2,880	2,880	100,00	P
C12	2	2,897	2,897	100,00	P
C13	2	2,893	2,893	100,00	P
C14	2	2,894	2,894	100,00	P
C15	2	2,899	2,899	100,00	P
C16	2	2,900	2,900	100,00	P
C17	2	2,897	2,897	100,00	P
C18	2	2,901	2,901	100,00	P
C19	2	2,905	2,905	100,00	P
C20	2	2,898	2,898	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	53,7	3,361	0,079	7,5	P
C2	1	53,7	3,324	0,079	11,6	P
C3	1	53,7	3,331	0,084	9,1	P
C4	1	53,7	3,336	0,079	14,9	P
C5	1	53,7	3,339	0,079	9,7	P
C6	1	53,7	3,334	0,079	5,4	P
C7	1	53,7	3,322	0,079	8,5	P
C8	1	53,7	3,325	0,084	12,3	P
C9	1	53,7	3,341	0,079	17,6	P
C10	1	53,7	3,328	0,079	8,0	P
C11	2	54,8	2,880	0,079	5,0	P
C12	2	54,8	2,897	0,079	1,1	P
C13	2	54,8	2,893	0,084	2,6	P
C14	2	54,8	2,894	0,079	3,6	P
C15	2	54,8	2,899	0,079	4,0	P
C16	2	56,2	2,900	0,079	4,2	P
C17	2	56,2	2,897	0,079	6,3	P
C18	2	56,2	2,901	0,084	2,7	P
C19	2	56,2	2,905	0,079	3,9	P
C20	2	56,2	2,898	0,079	3,2	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	21,7	3,345	0,8	P
C22	1	21,7	3,360	1,2	P
C23	1	21,7	3,342	1,6	P
C24	1	21,7	3,339	2,0	P
C25	1	21,7	3,352	1,7	P
C26	2	21,7	3,022	0,6	P
C27	2	21,7	2,987	0,4	P
C28	2	21,7	2,898	0,3	P
C29	2	21,7	2,960	0,4	P
C30	2	21,7	2,955	0,5	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
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Test H	TABLE6.5.4 Forced discharged			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C31	2	22,4	2,896	P
C32	2	22,4	3,006	P
C33	2	22,4	2,927	P
C34	2	22,4	2,956	P
C35	2	22,4	2,984	P
C36	2	22,4	2,945	P
C37	2	22,4	2,966	P
C38	2	22,4	2,958	P
C39	2	22,4	2,980	P
C40	2	22,4	2,926	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	22,9	3,364	P
C42	1	22,9	3,349	P
C43	1	22,9	3,338	P
C44	1	22,9	3,352	P
C45	1	22,9	3,350	P
Requirements: There shall be no explosion and no fire during this test. 1- Undischarged; 2- Fully discharged.				

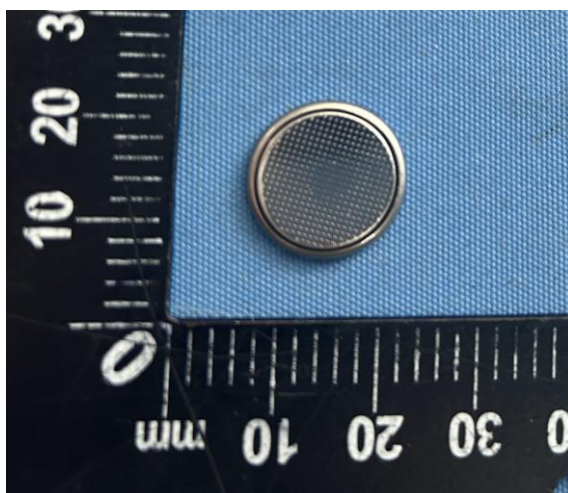
Test J	TABLE6.5.6 Free fall			P
Sample No.	Sample Status ¹⁾	Ambient temperature	OCV at start of test, Vdc	Results
C46	1	21,1	3,360	P
C47	1	21,1	3,358	P
C48	1	21,1	3,350	P
C49	1	21,1	3,349	P
C50	1	21,1	3,352	P
Requirements: There shall be no venting, no explosion and no fire during this test and within 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
C51	1	21,4	3,354	P
C52	1	21,4	3,353	P
C53	1	21,4	3,346	P
C54	1	21,4	3,350	P
C55	1	21,4	3,347	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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Attachment 1: Photos



---End Report---