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

Report Number. ..... :	SHES240200272701
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 ..... :	CR1620 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	Brian Han
	Approved by (name + signature) ..... :	Bruce Wu / Project Reviewer	Bruce Wu
☐	**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):	**Testing location:**
☒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	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 2024-03-18

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.

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:

Product description:	Primary Battery
Model:	CR1620 LITHIUM CELL
Rated voltage:	3,0 V
Rated capacity	70 mAh
Abnormal charge current:	1 mA
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=70 mAh, I_i=10 mA	P
6.5.5	Test I: Abnormal charging …..…..……..……..:	See Table 1 and 6.4.1 – 6.5.3 C_n=70 mAh, I_c=1 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; …..……..: 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 10 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 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
	Multi cell batteries	Undischarged	N/A		N/A
		Fully discharged	N/A		N/A
Test M	Cells and single cell batteries	Undischarged	50% prediscarged		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	3,370	3,369	99,97	P
C2	1	3,364	3,363	99,97	P
C3	1	3,363	3,363	100,00	P
C4	1	3,369	3,368	99,97	P
C5	1	3,367	3,366	99,97	P
C6	1	3,365	3,365	100,00	P
C7	1	3,364	3,364	100,00	P
C8	1	3,369	3,368	99,97	P
C9	1	3,354	3,353	99,97	P
C10	1	3,368	3,368	100,00	P
C11	2	2,874	2,874	100,00	P
C12	2	2,874	2,874	100,00	P
C13	2	2,874	2,874	100,00	P
C14	2	2,871	2,871	100,00	P
C15	2	2,870	2,870	100,00	P
C16	2	2,860	2,860	100,00	P
C17	2	2,861	2,861	100,00	P
C18	2	2,872	2,872	100,00	P
C19	2	2,861	2,861	100,00	P
C20	2	2,858	2,858	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	3,369	3,358	99,66	P
C2	1	3,363	3,354	99,74	P
C3	1	3,363	3,360	99,92	P
C4	1	3,368	3,362	99,82	P
C5	1	3,366	3,366	100,00	P
C6	1	3,365	3,360	99,85	P
C7	1	3,365	3,363	99,97	P
C8	1	3,368	3,364	99,89	P
C9	1	3,353	3,345	99,77	P
C10	1	3,368	3,359	99,74	P
C11	2	2,874	2,872	99,92	P
C12	2	2,874	2,869	99,82	P
C13	2	2,874	2,874	100,00	P
C14	2	2,871	2,867	99,85	P
C15	2	2,870	2,869	99,97	P
C16	2	2,860	2,857	99,87	P
C17	2	2,861	2,859	99,94	P
C18	2	2,862	2,861	99,97	P
C19	2	2,861	2,861	100,00	P
C20	2	2,858	2,858	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	3,358	3,356	99,94	P
C2	1	3,354	3,353	99,97	P
C3	1	3,360	3,360	100,00	P
C4	1	3,362	3,361	99,97	P
C5	1	3,366	3,365	99,97	P
C6	1	3,360	3,360	100,00	P
C7	1	3,363	3,362	99,97	P
C8	1	3,364	3,363	99,97	P
C9	1	3,345	3,354	100,00	P
C10	1	3,359	3,358	99,97	P
C11	2	2,872	2,871	99,94	P
C12	2	2,869	2,869	100,00	P
C13	2	2,874	2,872	99,94	P
C14	2	2,867	2,866	99,97	P
C15	2	2,869	2,868	99,97	P
C16	2	2,857	2,855	99,94	P
C17	2	2,859	2,858	99,97	P
C18	2	2,861	2,861	100,00	P
C19	2	2,861	2,861	100,00	P
C20	2	2,858	2,858	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	3,356	3,356	100,00	P
C2	1	3,353	3,353	100,00	P
C3	1	3,360	3,360	100,00	P
C4	1	3,361	3,360	99,97	P
C5	1	3,365	3,365	100,00	P
C6	1	3,360	3,360	100,00	P
C7	1	3,362	3,362	100,00	P
C8	1	3,363	3,363	100,00	P
C9	1	3,345	3,345	100,00	P
C10	1	3,358	3,358	100,00	P
C11	2	2,871	2,871	100,00	P
C12	2	2,869	2,869	100,00	P
C13	2	2,872	2,872	100,00	P
C14	2	2,866	2,866	100,00	P
C15	2	2,868	2,868	100,00	P
C16	2	2,855	2,855	100,00	P
C17	2	2,858	2,858	100,00	P
C18	2	2,861	2,861	100,00	P
C19	2	2,861	2,861	100,00	P
C20	2	2,858	2,858	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	53,0	3,356	0,079	7,4	P
C2	1	53,0	3,353	0,079	10,7	P
C3	1	53,0	3,360	0,084	15,0	P
C4	1	53,0	3,360	0,079	10,7	P
C5	1	53,0	3,365	0,079	9,9	P
C6	1	53,2	3,360	0,079	10,8	P
C7	1	53,2	3,362	0,079	12,9	P
C8	1	53,2	3,363	0,084	16,4	P
C9	1	53,2	3,345	0,079	11,3	P
C10	1	53,2	3,358	0,079	9,5	P
C11	2	54,1	2,871	0,079	12,7	P
C12	2	54,1	2,869	0,079	4,2	P
C13	2	54,1	2,872	0,084	1,8	P
C14	2	54,1	2,866	0,079	3,9	P
C15	2	54,1	2,868	0,079	3,2	P
C16	2	54,7	2,855	0,079	3,8	P
C17	2	54,7	2,858	0,079	4,0	P
C18	2	54,7	2,861	0,084	3,9	P
C19	2	54,7	2,861	0,079	0,6	P
C20	2	54,7	2,858	0,079	4,9	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	3,348	1,1	P
C22	1	21,7	3,358	1,2	P
C23	1	21,7	3,362	1,0	P
C24	1	21,7	3,363	1,2	P
C25	1	21,7	3,369	1,4	P
C26	2	21,7	2,889	0,8	P
C27	2	21,7	2,946	0,9	P
C28	2	21,7	2,962	1,0	P
C29	2	21,7	2,987	0,6	P
C30	2	21,7	2,960	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
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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	21,6	2,912	P
C32	2	21,6	3,006	P
C33	2	21,6	2,960	P
C34	2	21,6	2,943	P
C35	2	21,6	2,952	P
C36	2	21,6	2,947	P
C37	2	21,6	2,955	P
C38	2	21,6	2,960	P
C39	2	21,6	2,899	P
C40	2	21,6	2,868	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	21,6	3,368	P
C42	1	21,6	3,364	P
C43	1	21,6	3,367	P
C44	1	21,6	3,365	P
C45	1	21,6	3,365	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	21,6	3,368	P
C47	1	21,6	3,366	P
C48	1	21,6	3,364	P
C49	1	21,6	3,365	P
C50	1	21,6	3,363	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	3,366	P
C52	1	21,4	3,366	P
C53	1	21,4	3,367	P
C54	1	21,4	3,369	P
C55	1	21,4	3,363	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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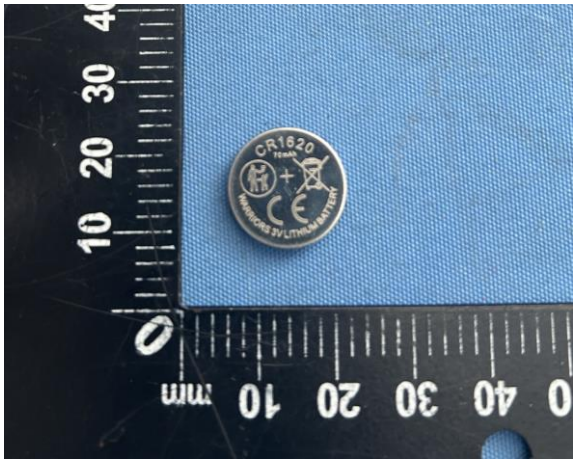
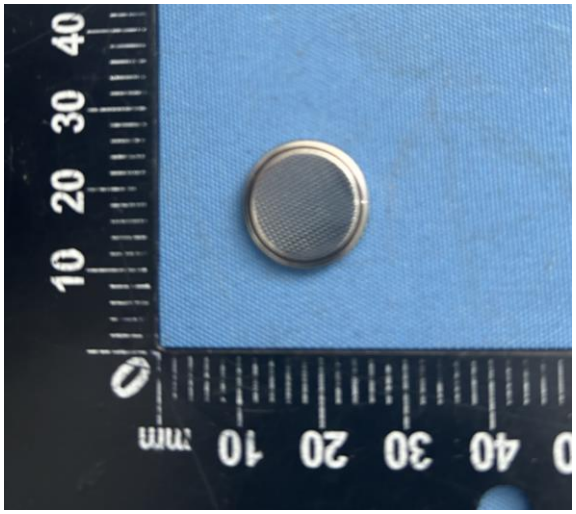
Attachment 1: Photos





---End Report---