Test Report

Report No.: RCT20230103-2
Date: 2023-01-03

Applicant:	**GUANGXI AGAWO NEW ENERGY TECHNOLOGY CO., LTD** **3# STANDARD WORKSHOP ,HIGH-TECH DEVELOPMENT ZONE II QINZHOU ,GUANGXI**
Test object / Model :	**0% Hg Alkaline Button Cell/LR1130/L1131/AG10**
Additional models	**LR1130**
Test specifications / Test standard:	IEC/EN 60086-1: 2021 Clause 4.1.2, 5.3, 5.5, 5,7 IEC/EN 60086-2: 2021 Clause 6.4.4 IEC/EN 60086-5: 2021
Purpose of examination:	Test according to the test specification and client requirement.
Test result:	See below pages.
Brand name:	YONG LI CROWN

Assistant
Project Reviewer
Safety Laboratory

Supervisor
Project Engineer

SHENZHEN RCT TESTING TECHNOLOGY
Report Seal

1. General product description:

Alkaline zinc manganese battery

2. Battery rating:

Model:	LR1130 1.5V
Rated Voltage:	1.5 V

3. Test description:

Possible test case verdicts:

- test case does not apply to the test object:	N/A (Not Applicable)
- test object does meet the requirement:	P (Pass)
- test object does not meet the requirement:	F (Fail)

The tests were done in Shenzhen RCT Testing Technology Co., Ltd.
Test item was received on 2022-12-25
Tests were performed from 2022-12-25 to 2023-01-03.
Ambient: (20±2)°C and (55±20)% RH

4. Test procedure and result:

IEC 60086-1: 2021			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
4.1.2	Battery dimensions The dimensions for individual types of batteries are given in IEC 60086-2.	See appended table	P
5.3	Conformance check to a specified minimum average duration	See the test result	P
5.5	OVC testing Open-circuit voltage shall be measured with the voltage measuring equipment specified in 6.8.1.	See appended table	P
5.7	Leakage and deformation After the service output has been determined under the specified environmental conditions, the discharge shall be continued in the same way until the closed circuit voltage drops for the first time below 40% of the nominal voltage of the battery. The requirements of 4.1.3, 4.2.2 and 4.2.3 shall be met.		P

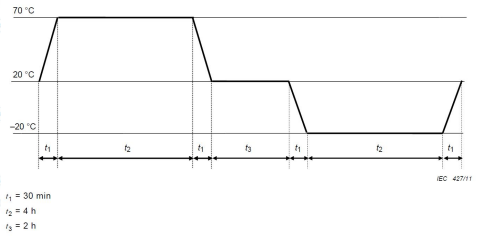
IEC 60086-2: 2021			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
6.4.4	Category 4 – Specifications: LR1130 1.5V	See the test result	P

IEC 60086-5: 2021			
Clause	**Requirement + Test**	**Result - Remark**	**Verdict**
6.2	Intended use		P
6.2.1	Intended use tests and requirements **Table 2 – Intended use tests and requirements** Test | | Intended use simulation | Requirements Electrical test | A | Storage after partial use | No leakage (NL) No fire (NF) No explosion (NE) Environmental tests | B-1 | Transportation-shock | No leakage (NL) No fire (NF) No explosion (NE) | B-2 | Transportation-vibration | No leakage (NL) No fire (NF) No explosion (NE) Climatic-temperature | C | Climatic-temperature cycling | No fire (NF) No explosion (NE)		P
6.2.2	Intended use test procedures		P
6.2.2.1	Test A – Storage after partial use		P

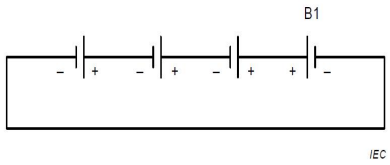
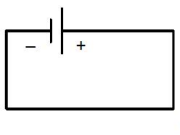
	a) Purpose This test simulates the situation when an appliance is switched off and the installed batteries are partly discharged. These batteries may be left in the appliance for a long time or they are removed from the appliance and stored for a long time. b) Test procedure An undischarged battery is discharged under an application/service output test condition, with the lowest resistive load test as defined in IEC 60086-2 until the service life falls by 50 % of the minimum average duration (MAD) value, followed by storage at (45 ± 5) °C for 30 days. c) Requirements There shall be no leakage, no fire and no explosion during this test.		P
6.2.2.2	Test B-1 – Transportation-shock		P

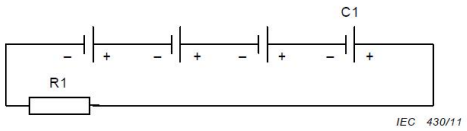
<table>
<tr><td></td><td>a) Purpose
This test simulates the situation when an appliance is carelessly dropped with batteries installed in it. This test condition is generally specified in IEC 60068-2-27.
b) Test procedure
An undischarged battery shall be tested as follows. The shock test shall be carried out under the conditions defined in Table 3 and the sequence in Table 4.
Shock pulse – The shock pulse applied to the battery shall be as follows:
Table 3 – Shock pulse
<table>
<tr><th colspan="2">Acceleration</th><th rowspan="2">Waveform</th></tr>
<tr><th>Minimum average acceleration first three milliseconds</th><th>Peak acceleration</th></tr>
<tr><td>75 g_n</td><td>125 g_n to 175 g_n</td><td>Half sine</td></tr>
<tr><td colspan="3">NOTE g_n = 9,80665 m/s².</td></tr>
</table>
Table 4 – Test sequence
<table>
<tr><th>Step</th><th>Storage time</th><th>Battery orientation</th><th>Number of shocks</th><th>Visual examination periods</th></tr>
<tr><td>1</td><td>–</td><td>–</td><td>–</td><td>Pre-test</td></tr>
<tr><td>2</td><td>–</td><td>a</td><td>1 each</td><td>–</td></tr>
<tr><td>3</td><td>–</td><td>a</td><td>1 each</td><td>–</td></tr>
<tr><td>4</td><td>–</td><td>a</td><td>1 each</td><td>–</td></tr>
<tr><td>5</td><td>1 h</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>6</td><td>–</td><td>–</td><td>–</td><td>Post-test</td></tr>
<tr><td colspan="5">[a] The shock shall be applied in each of three mutually perpendicular directions.</td></tr>
</table>
Step 1 Record open circuit voltage in accordance with 5.2.
Steps 2 to 4 Apply shock test specified in Table 3 and the sequence in Table 4.
Step 5 Rest battery for 1 h.
Step 6 Record examination results.
c) Requirements
There shall be no leakage, no fire and no explosion during this test.</td><td></td><td>P</td></tr>
<tr><td>6.2.2.3</td><td>Test B-2 – Transportation-vibration</td><td></td><td>P</td></tr>
</table>

<table>
<tr><td></td><td>a) Purpose
This test simulates vibration during transportation. This test condition is generally specified in IEC 60068-2-6.
b) Test procedure
An undischarged battery shall be tested as follows. The vibration test shall be carried out under the following test conditions and the sequence in Table 5. Vibration – A simple harmonic motion shall be applied to the battery having an amplitude of 0,8 mm, with a total maximum excursion of 1,6 mm. The frequency shall be varied at the rate of 1 Hz/min between the limits of 10 Hz and 55 Hz. The entire range of frequencies (10 Hz to 55 Hz) and return (55 Hz to 10 Hz) shall be traversed in (90 ± 5) min for each mounting position (direction of vibration).
Table 5 – Test sequence
<table>
<tr><th>Step</th><th>Storage time</th><th>Battery orientation</th><th>Vibration time</th><th>Visual examination periods</th></tr>
<tr><td>1</td><td>–</td><td>–</td><td>–</td><td>Pre-test</td></tr>
<tr><td>2</td><td>–</td><td>a</td><td>(90 ± 5) min each</td><td>–</td></tr>
<tr><td>3</td><td>–</td><td>a</td><td>(90 ± 5) min each</td><td>–</td></tr>
<tr><td>4</td><td>–</td><td>a</td><td>(90 ± 5) min each</td><td>–</td></tr>
<tr><td>5</td><td>1 h</td><td>–</td><td>–</td><td>–</td></tr>
<tr><td>6</td><td>–</td><td>–</td><td>–</td><td>Post-test</td></tr>
<tr><td colspan="5">[a] The vibration shall be applied in each of three mutually perpendicular directions.</td></tr>
</table>
Step 1 Record open circuit voltage in accordance with 5.2.
Steps 2 to 4 Apply the vibration specified in 6.2.2.3 in the sequence in Table 5.
Step 5 Rest battery for 1 h.
Step 6 Record examination results.
c) Requirements
There shall be no leakage, no fire and no explosion during this test.</td><td></td><td>P</td></tr>
<tr><td>6.2.2.4</td><td>Test C – Climatic-temperature cycling</td><td></td><td>P</td></tr>
</table>

	a) Purpose This test assesses the integrity of the battery seal which may be impaired after temperature cycling. b) Test procedure An undischarged battery shall be tested under the following procedure. Temperature cycling procedure (see 1) to 7) below and/or Figure 2) 1) Place the batteries in a test chamber and raise the temperature of the chamber to (70 ± 5) °C within $t1$ = 30 min. 2) Maintain the chamber at this temperature for $t2$ = 4 h. 3) Reduce the temperature of the chamber to (20 ± 5) °C within $t1$ = 30 min and maintain at this temperature for $t3$ = 2 h. 4) Reduce the temperature of the chamber to (–20 ± 5) °C within $t1$ = 30 min and maintain at this temperature for $t2$ = 4 h. 5) Raise the temperature of the chamber to (20 ± 5) °C within $t1$ = 30 min. 6) Repeat the sequence for a further nine cycles. 7) After the 10th cycle, store the batteries for seven days prior to examination.  **Figure 2 – Temperature cycling procedure** c) Requirements There shall be no fire and no explosion during this test.		P
6.3	Reasonably foreseeable misuse		P
6.3.1	Reasonably foreseeable misuse tests and requirements **Table 6 – Reasonably foreseeable misuse tests and requirements**		P
6.3.2	Reasonably foreseeable misuse test procedures		P

Test		Misuse simulation	Requirements
Electrical tests	D	Incorrect installation	No fire (NF) No explosion (NE)*
	E	External short circuit	No fire (NF) No explosion (NE)
	F	Overdischarge	No fire (NF) No explosion (NE)
Environmental test	G	Free fall	No fire (NF) No explosion (NE)
* See NOTE 2 of 6.3.2.1b)			

6.3.2.1	Test D – Incorrect installation (four batteries in series)		N/A
	a) Purpose This test simulates the condition when one battery in a set is reversed. b) Test procedure Four undischarged batteries of the same brand, type and origin shall be connected in series with one reversed (B1) as shown in Figure 3. The circuit shall be completed for 24 h or until the battery case temperature has returned to ambient. The resistance of the inter-connecting circuitry shall not exceed 0,1 Ω  **Figure 3 – Circuit diagram for incorrect installation (four batteries in series)** c) Requirements There shall be no fire and no explosion during this test		N/A
6.3.2.2	Test E – External short circuit		P
	a) Purpose This misuse may occur during daily handling of batteries. b) Test procedure An undischarged battery shall be connected as shown in Figure 4. The circuit shall be completed for 24 h or until the battery case temperature has returned to ambient. The resistance of the inter-connecting circuitry shall not exceed 0,1 Ω.  **Figure 4 – Circuit diagram for external short circuit** c) Requirements There shall be no fire and no explosion during this test.		P

6.3.2.3	Test F – Overdischarge		N/A
	a) Purpose This test simulates the condition when one (1) discharged battery is series-connected with three (3) other undischarged batteries. b) Test procedure One undischarged battery (C1) is discharged under the application or service output test condition, with the highest MAD value (expressed in time units), as defined in IEC 60086-2 until the on-load voltage falls to (*n* x 0,6 V) where *n* is the number of cells in the battery. Then, three undischarged batteries and one discharged battery (C1) of the same brand, type and origin shall be connected in series as shown in Figure 5. The discharge shall be continued until the total on-load voltage falls to four times (*n* x 0,6 V). The value of the resistor (R1) shall be approximately four times the lowest value from the resistive load tests specified for that battery in IEC 60086-2. The final value of the resistor (R1) shall be the nearest value to that prescribed in 6.4 of IEC 60086-1.  **Figure 5 – Circuit diagram for overdischarge** c) Requirements There shall be no fire and no explosion during this test.		N/A
6.3.2.4	Test G – Free fall test		P

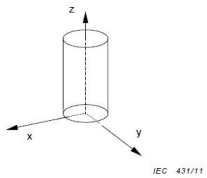
	a) Purpose This test simulates the situation when a battery is accidentally dropped. The test condition is based upon IEC 60068-2-31. b) Test procedure Undischarged test batteries shall be dropped from a height of 1 m onto a concrete surface. Each test battery shall be dropped six times, a prismatic battery once on each of its six faces, a round battery twice in each of the three axes shown in Figure 6. The test batteries shall be stored for 1 h afterwards. c) Requirements There shall be no fire and no explosion during this test.  Figure 6 – XYZ axes for free fall		P

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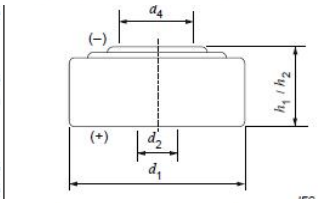
TABLE	Battery dimensions					P
Sample No.	OCV/V	h1/h2/mm	d1/mm	d2/mm	d4/mm	Result
1	1,58	5,22	11,392	3,802	7,603	Pass
2	1,57	5,22	11,370	3,840	7,680	Pass
3	1,58	5,23	11,393	3,838	7,675	Pass
4	1,57	5,23	11,402	3,813	7,625	Pass
5	1,58	5,24	11,378	3,802	7,604	Pass
6	1,57	5,23	11,387	3,844	7,688	Pass
7	1,58	5,22	11,406	3,812	7,623	Pass
8	1,57	5,23	11,401	3,814	7,628	Pass

Supplementary information:



h_1 / h_2	max.	3,6	2,1	3,05	4,2	5,4
	min.	3,3	1,85	2,75	3,8	5,0
d_1	max.	7,9	11,6	11,6	11,6	11,6
	min.	7,55	11,25	11,25	11,25	11,25
d_2	min.	3,8	3,8	3,8	3,8	3,8
d_4	min.	3,0	3,8	3,8	3,8	3,8

Common designation				192	191	189, LR1130	186	A76
V_n (V)				1,5	1,5	1,5	1,5	1,5
OCV max. (V)				1,68	1,68	1,68	1,68	1,68
Delayed discharge performance after 12 months (% of MAD)				90	90	90	90	90
Applications	Load	Daily Period	EV (V)	MAD[a] (Initial)				
Service output test	22 kΩ	24 h	1,2	300 h	No Test	No Test	No Test	No Test
Service output test	22 kΩ	24 h	1,2	No Test	275 h	No Test	No Test	No Test
Service output test	15 kΩ	24 h	1,2	No Test	No Test	350 h	No Test	No Test
Service output test	10 kΩ	24 h	1,2	No Test	No Test	No Test	359 h	No Test
Service output test	6,8 kΩ	24 h	1,2	No Test	No Test	No Test	No Test	340 h

[a] Standard conditions (see IEC 60086-1:2015, Table 3, Initial discharge test).

Discharge Condition			
R/kΩ	Daily period	EV	MAD (initial)
6,8	24 h	1,2	340 h

Result		
Sample No.	Initial discharge	Verdict
1	636,8	Pass
2	617,3	Pass
3	640,2	Pass
4	632,2	Pass
5	625,1	Pass
6	631,5	Pass
7	646,5	Pass
8	627,6	Pass

TABLE A	Test A – Storage after partial use (Clause 6.2.2.1)
Test sample No.	#1, #2, #3, #4, #5
Result	Pass
Requirements: There shall be no leakage, no fire and no explosion during this test.	

TABLE B-1	Test B-1 – Transportation-shock (Clause 6.2.2.2)
Test sample No.	#6, #7, #8, #9, #10
Result	Pass
Requirements: There shall be no leakage, no fire and no explosion during this test.	

TABLE B-2	Test B-2 – Transportation-vibration (Clause 6.2.2.3)
Test sample No.	#16, #17, #18, #19, #20

Result	Pass
Requirements: **There shall be no leakage, no fire and no explosion during this test.**	

TABLE C	**Test C – Climatic-temperature cycling (Clause 6.2.2.4)**
Test sample No.	#21, #22, #23, #24, #25
Result	Pass
Requirements: There shall be no fire and no explosion during this test.	

TABLE E	**Test E – External short circuit (Clause 6.3.2.2)**
Test sample No.	#31, #32, #33, #34, #35
Result	Pass
Requirements: There shall be no fire and no explosion during this test.	

TABLE G	**Test G – Free fall test (Clause 6.3.2.4)**
Test sample No.	#41, #42, #43 #44, #45
Result	Pass
Requirements: There shall be no fire and no explosion during this test.	

Attachment: Photo

NOTES TO THIS TEST REPORT

1. The following language(s) of marking(s) and instruction sheets were submitted during the test application:
   - English

   According to the standard, instruction sheets and other texts required by the standard should be written in the official language(s) of the country in which the product is to be sold. The applicant should ensure that the product in future production fulfils the receptive standard requirements.

2. The components performed satisfactorily during testing and are considered to be suitable for use in the sample tested. Acceptances of the safety critical components and materials were based on:
   - the certification record(s) and/or test report submitted by the applicant; or
   - component / material tested with the appliance

   Detail shall be referred to the component list on the appendix of this test report.

- - - End of Report - - -