

TEST REPORT IEC 62619 Secondary cells and batteries containing alkaline or other non-acid electrolytes - Safety requirements for secondary lithium cells and batteries, for use in industrial applications	
Report reference No.....	THJS21051731000R
Compiled by (+ signature).....	Stephen Zhang / Test Engineer
Approved by (+ signature).....	Kosco Vent / Project Manager
Date of issue.....	November 15,2021
Testing laboratory.....	Shanghai Global Testing Services Co., Ltd.
Testing location.....	Floor 2nd, Building D-1, No. 128, Shenfu Road, Minhang District, Shanghai, China.
Applicant.....	Lithium Werks (China) Manufacturing Co., Ltd
Address.....	No.8, BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China
Manufacturer.....	Lithium Werks (China) Manufacturing Co., Ltd
Address.....	No.8, BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China
Factory.....	The same as applicant
Address.....	
Standard.....	<input checked="" type="checkbox"/> IEC 62619: 2017
Test Report Form No.....	IEC62619A
TRF originator.....	GTS
Master TRF.....	Dated 2018-06-07
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Test item description :	Rechargeable Li-ion Cell	
Trade Mark	/	
Manufacturer :	Lithium Werks (China) Manufacturing Co., Ltd No.8, BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China	
Model/Type reference :	26650M1B, Gen 4.0 26650MIB	
Ratings :	26650M1B: 3.3V, 2.56 Ah +/- 0.1 Ah, 8.25Wh; Gen 4.0 26650MIB: 3.3V, 2.6 Ah +/- 0.1 Ah, 8.58Wh	
Responsible Testing Laboratory (as applicable), testing procedure and testing location(s):		
<input type="checkbox"/>	CB Testing Laboratory:	
Testing location/ address:		
Tested by (name, function, signature):		See first page
Approved by (name, function, signature) ...:		See first page
<input type="checkbox"/>	Testing procedure: CTF Stage 1:	
Testing location/ address:		
Tested by (name, function, signature):		
Approved by (name, function, signature) ...:		
<input type="checkbox"/>	Testing procedure: CTF Stage 2:	
Testing location/ address:		
Tested by (name + signature)		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature) ...:		
<input type="checkbox"/>	Testing procedure: CTF Stage 3:	
<input type="checkbox"/>	Testing procedure: CTF Stage 4:	
Testing location/ address:		
Tested by (name, function, signature):		
Witnessed by (name, function, signature) ..:		
Approved by (name, function, signature) ...:		
Supervised by (name, function, signature) :		

List of Attachments (including a total number of pages in each attachment): Attachment 1: Photo Documentation	
Summary of testing:	
Tests performed (name of test and test clause): cl.7.2.3.3 Edge and corner drop test (Battery system) Functional safety test: cl.8.2.2 Overcharge control of voltage (Battery system) cl.8.2.3 Overcharge control of current (Battery system) cl.8.2.4 Overheating control (Battery system) The component cell (26650M1B) was evaluated according to IEC 62619: 2017 by GTS The samples comply with the requirement of IEC 62619: 2017.	Testing location: Shanghai Global Testing Services Co., Ltd. Floor 2nd, Building D-1, No. 128, Shenfu Road, Minhang District, Shanghai, China.
Summary of compliance with National Differences (List of countries addressed): N/A	
<input checked="" type="checkbox"/> The product fulfils the requirement of <u>EN 62619:2017</u>	

Copy of marking plate

Lithium Werks (China) Manufacturing Co., Ltd.			
Rechargeable Li-ion Cell			
Model	26650M1B	Power	> 4000 W/kg
Voltage	3.3V	Weight	76g +/- 1.0g
Capacity	2.56 Ah +/- 0.1 Ah	Energy	8.25Wh
No.8, <u>BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China</u>			
Tel:+4794793432 Arvin.Chen@lithiumwerks.com			

Lithium Werks (China) Manufacturing Co., Ltd.			
Rechargeable Li-ion Cell			
Model	Gen 4.0 26650MIB	Power	> 4000 W/kg
Voltage	3.3V	Weight	76g +/- 1.0g
Capacity	2.6 Ah +/- 0.1 Ah	Energy	8.58Wh
No.8, <u>BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China</u>			
Tel:+4794793432 Arvin.Chen@lithiumwerks.com			

Test item particulars	
Classification of installation and use: To be defined in final product	
Supply Connection: Not directly connected to mains:	
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 : October 28,2021	
Date (s) of performance of tests : October 28,2021 to November 15,2021	
General remarks:	
"(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 <input type="checkbox"/> comma / <input checked="" type="checkbox"/> point is used as the decimal separator.	
Manufacturer's Declaration per sub-clause 4.2.5 of IEC60335-1:	
The application for obtaining a CB 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..... :	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> Not applicable
When differences exist; they shall be identified in the General product information section.	
Name and address of factory (ies) : Lithium Werks (China) Manufacturing Co., Ltd No.8, BeiHai Road Comprehensive Free Trade Zone, Xinbei District, Changzhou, Jiangsu, China	

**General product information and other remarks:
The main features of the battery are shown as below**

Product name	Rechargeable Li-ion Cell
Model	26650M1B, Gen 4.0 26650MIB
Nominal Ratings	
Voltage	3.3 V
Capacity @ 25°C	26650M1B: 2.56 Ah +/- 0.1 Ah Gen 4.0 26650MIB: 2.6 Ah +/- 0.1 Ah
Energy @ 25°C	26650M1B: 8.25Wh Gen 4.0 26650MIB: 8.58Wh
Specific Power @ 25 °C, 2 sec pulse	> 4000 W/kg
Impedance (1kHz AC) Typical	6mΩ
Cycle Life @ 1C/1C, 100% DOD	4000 Cycles
Discharging	
Max. Continuous Discharge Current	50 A (20C rate)
Max. Pulse Discharge Current (10s)	120 A (48C rate)
Minimum Voltage / HPPC Pulse	2V / 1.6V
Temperature	-30°C to 60°C
Charging	
Recommended Charge Current	3 A (1.2C rate)
Max. Continuous Charge Current	10 A (4C rate)
Max. Pulse Charge Current (10s)	20 A (8C rate)
Float Voltage	3.45 V
Recommended Charge V & Cut-Off Current	3.6 V, taper to 125 mA
Temperature Range (reduce charging current to 250mA when under 0°C)	-20 °C to 60 °C
Storage	
Storage Temperature	-40 °C to 70 °C
Mechanical	
Diameter	Ø25.96 +/- 0.5mm
Length	65.15 +/- 0.5mm
Mass	76g +/- 1.0g
Certifications	
Transportation	UN 3480 (UN38.3), CIQ
Safety	UL 1642, IEC 62133-2
Environmental	REACH, RoHS, ISO-14001
Quality System	TS/IATF-16949, ISO-9001
Transportation	
Shipped	Via Air @ 30% SOC Via Sea @ 50% SOC
Part Number 300732-006	

IEC 62619			
Clause	Requirement + Test	Result - Remark	Verdict
4	PARAMETER MEASUREMENT TOLERANCES		P
	Parameter measurement tolerances		P
5	GENERAL SAFETY CONSIDERATIONS		P
5.1	General		P
	Cells and batteries are safe under conditions of both intended use and reasonably foreseeable misuse...	Multiple layers of protection are employed at the chemistry, cell and system level to achieve an energy storage solution with superior safety and abuse tolerance compared to metal oxide lithium-ion chemistries	P
5.2	Insulation and wiring		P
	Voltage, current, altitude, and humidity requirements	See page 6	P
	Adequate clearances and creepage distances between connectors		N/A
	The mechanical integrity of internal connections		P
5.3	Venting		N/A
	Pressure relief function		N/A
	Encapsulation used to support cells within an outer casing		P
5.4	Temperature/voltage/current management		P
	The design prevents abnormal temperature-rise		N/A
	Voltage, current, and temperature limits of the cells	See page 6	P
	Specifications and charging instructions for equipment manufacturers	See page 6	P
5.5	Terminal contacts of the battery pack and/or battery system		P
	Polarity marking(s)		P
	Capability to carry the maximum anticipated current	10 A (4C rate)	P
	External terminal contact surfaces		P
	Terminal contacts are arranged to minimize the risk of short circuits		P
5.6	Assembly of cells, modules, or battery packs into battery systems		P
5.6.1	General		P
	Independent control and protection method(s)		N/A
	Recommendations of cell operating limits by the cell manufacturer	Recommended Charge V & Cut-Off Current:3.6 V, taper to 125 mA	P

	Batteries designed for the selective discharge of a portion of their series connected cells		N/A
	Protective circuit component(s) and consideration to the end-device application		P
5.6.2	Battery system design		P
	The voltage control function		P
	The voltage control for series-connected batteries		N/A
5.7	Operating region of lithium cells and battery systems for safe use		P
	The cell operating region..... :	Listed in the specification of cell.	P
	Designation of battery system to comply with the cell operating region	Information mentioned in manufacturer's specifications.	P
5.8	Quality plan		P
	Manufacturing quality plan (for example: ISO9001, etc.) prepared and implemented.....:	Reference: ISO 9001 certificate provided.	P
	The process capabilities and the process controls		P

6	TYPE TEST CONDITIONS		P
6.1	General		P
6.2	Test items		P
	Cells or batteries that are not more than six months old (See Table 1 of IEC62619)		P
	Capacity confirmation of the cells or batteries		P
	Default ambient temperature of test, 25 °C ± 5 °C	Tests were carried out in an ambient temperature of 25±5°C.	P

7	SPECIFIC REQUIREMENTS AND TESTS		P
7.1	Charging procedure for test purposes		P
	The battery discharged to a specified final voltage prior to charging		P
	The cells or batteries charged using the method specified by the manufacturer	The method mentioned in manufacturer's specifications.	P
7.2	Reasonably foreseeable misuse		P
7.2.1	External short-circuit test (cell or cell block)		N/A
	Short circuit with total resistance of 30 mΩ± 10 mΩ at 25 °C ± 5 °C	6mΩ	N/A
	Results: no fire, no explosion		N/A
7.2.2	Impact test (cell or cell block)		N/A
	Cylindrical cell, longitudinal axis impact		N/A

	Prismatic cell, longitudinal axis and lateral axis impact		N/A
	Results: no fire, no explosion.		N/A
7.2.3	Drop test (cell or cell block, and battery system)		P
7.2.3.1	General		P
7.2.3.2	Whole drop test (cell or cell block, and battery system)	The mass of cell is 76g +/- 1.0g	P
	Description of the Test Unit		—
	Mass of the test unit (kg).....		—
	Height of drop (m).....		—
	Results: no fire, no explosion		P
7.2.3.3	Edge and corner drop test (cell or cell block, and battery system)		P
	Description of the Test Unit		—
	Mass of the test unit (kg).....		—
	Height of drop (m).....		—
	Results: no fire, no explosion	No fire, no explosion.	P
7.2.4	Thermal abuse test (cell or cell block)		P
	Results: no fire, no explosion		P
7.2.5	Overcharge test (cell or cell block)		N/A
	For those battery systems that are provided with only a single protection for the charging voltage control		—
	Results: no fire, no explosion		N/A
7.2.6	Forced discharge test (cell or cell block)		N/A
	Upper limit charge voltage of the cell		N/A
	Cells connected in series in the battery system		N/A
	Redundant or single protection for discharge voltage control provided in battery system		N/A
	Target Voltage.....		N/A
	Maximum discharge current of the cell, I _m		N/A
	Discharge current for forced discharge, 1.0 It.....		N/A
	Discharging time, t = (1It / I _m) x 90 (min.)		N/A
	Results: no fire, no explosion		N/A
7.3	Considerations for internal short-circuit – Design evaluation		N/A
7.3.1	General		N/A

7.3.2	Internal short-circuit test (cell)		N/A
	Samples preparation procedure: a), in accordance with 8.3.9 of IEC62133:2012; or b), the nickel particle inserted before charging, or c), the nickel particle was inserted before electrolyte filling		N/A
	Tested according to Cl. 8.3.9 of IEC 62133:2012 test method, except all tests were carried out in an ambient temperature of 25 °C ± 5 °C.		N/A
	The appearance of the short-circuit location recorded by photograph or other means		—
	The pressing was stopped - When a voltage drop of 50 mV was detected; or		N/A
	- The pressing force of 800 N (cylindrical cells) or 400 N (prismatic cells) was reached		N/A
	Results: no fire, no explosion		N/A
7.3.3	Propagation test (battery system)		N/A
	Method to create a thermal runaway in one cell ... :		N/A
	Results: No external fire from the battery system or no battery case rupture..... :		N/A

8	BATTERY SYSTEM SAFETY (CONSIDERING FUNCTIONAL SAFETY)		P
8.1	General requirements		P
	Functional safety analysis for critical controls	According to UL 1642, IEC 62133-2	P
	Conduct of a process hazard, risk assessment and mitigation of the battery system		P
8.2	Battery management system (or battery management unit)		P
8.2.1	Requirements for the BMS		P
	The safety integrity level (SIL) target of the BMS		P
	The charge control evaluated by tests in clauses 8.2.2 to 8.2.4		P
8.2.2	Overcharge control of voltage (battery system)		P
	The exceeded charging voltage applied to the whole battery system		P
	The exceeded charging voltage applied to only a part of the battery system, such as the cell(s)		N/A
	Results: no fire, no explosion		P

	The BMS interrupted the overcharging before reaching 110% of the upper limit charging voltage	Tested complied.	P
8.2.3	Overcharge control of current (battery system)		P
	Results:no fire, no explosion :	See Table 8.2.3	P
	The BMS detected the overcharging current and controlled the charging to a level below the maximum charging current	Tested complied.	P
8.2.4	Overheating control (battery system)		N/A
	The cooling system, if provided, was disconnected	Reduce charging current to 250mA when under 0°C	N/A
	Elevated temperature for charging, 5 °C above maximum operating temperature..... :		N/A
	Results:no fire, no explosion :		N/A
	The BMS detected the overheat temperature and terminated charging		N/A
	The battery system operated as designed during test		N/A

9	INFORMATION FOR SAFETY		P
	The cell manufacturer provides information about current, voltage and temperature limits of their products		P
	The battery system manufacturer provides information regarding how to mitigate hazards to equipment manufacturers or end-users.		P

10	MARKING AND DESIGNATION (REFER TO CLAUSE 5 OF IEC 62620)		P
	The marking items shown in Table 1 in IEC 62620 indicated on the cell, battery system or instruction manual.		P
	Cell or battery system has clear and durable markings		P
	Cell designation		P
	Battery designation		P
	Battery structure formulation		P

ANNEX A OPERATING REGION OF CELLS FOR SAFE USE			P
A.1	General		P
A.2	Charging conditions for safe use		P
A.3	Consideration on charging voltage		P
A.4	Consideration on temperature		P
A.5	High temperature range	Charging high temperature declared by client is: 60°C	P
A.6	Low temperature range	Charging low temperature declared by client is: -20°C	P
A.7	Discharging conditions for safe use		P
A.8	Example of operating region		P

ANNEX B PROCEDURE OF 7.3.3 PROPAGATION TEST			N/A
B.1	General		N/A
B.2	Test conditions:		N/A
	– The battery fully charged according to the manufacturer recommended conditions.....:		—
	– Target cell forced into thermal runaway		—
	– A specially prepared sample (e.g. a heater or a hole for nail penetration provided) used for ease of testing.....:		—
B.3	Method used for initiating the thermal runaway. 1) Heater (Heater, Burner, Laser, Inductive heating) 2) Overcharge 3) Nail penetration of the cell 4) Combination of above methods 5) Other methods		—

ANNEX C PACKAGING			P
	The materials and pack design chosen in such a way as to prevent the development of unintentional electrical conduction, corrosion of the terminals and ingress of environmental contaminants		P

7.2.1	TABLE: External short-circuit test (cell or cell block)					N/A
Sample No.	Ambient (at 25°C ± 5°C)	OCV at start of test (Vdc)	Resistance of Circuit (mΩ)	Maximum Case Temperature (°C)	Results	

Supplementary information:
 A - No fire or Explosion
 B - Fire
 C - Explosion
 D - The test was completed after 6 h
 E - The test was completed after the cell casing cooled to 20% of the maximum temperature rise
 F - Other (Please explain): _____

7.2.5	TABLE: Overcharge test (cell or cell block)					N/A
Sample No.	OCV at start of test (Vdc)	OCV at end of test (Vdc)	Measured Maximum Charging Current (A)	Measured Maximum Charging Voltage (Vdc)	Max. Cell Case Temperature, (°C)	Results

Supplementary information:
 Results:
 A - No fire or Explosion
 B - Fire
 C - Explosion
 D - Test concluded when temperature reached a steady state condition
 E - Test concluded when temperature returned to ambient
 F - Other (Please explain): _____

7.2.6	TABLE: Forced discharge test (cell or cell block)				N/A
Sample No.	OCV before applying reverse charge, (Vdc)	Target Voltage (Vdc)	Measured Reverse Charge Current I _t , (A)	Total Time for Reversed Charge Application (min)	Results

Supplementary information:
 Results:
 A - No fire or Explosion
 B - Fire
 C - Explosion
 D - Other (Please explain): ____

7.3.2	TABLE: Internal short-circuit test (cell)			N/A
Sample No.	OCV at start of test, (Vdc)	Particle location ¹⁾	Maximum applied pressure, (N)	Results

Supplementary information:
¹⁾Identify one of the following:
 1: Nickel particle inserted between positive and negative (active material) coated area.
 2: Nickel particle inserted between positive aluminium foil and negative active material coated area.

Results:
 A - No fire or explosion
 B - Fire
 C - Explosion
 D - Test concluded when 50 mV voltage drop occurred prior to reaching force limit
 E - Test concluded when 800/400 N pressure was reached and 50 mV voltage drop was not achieved
 F - Test was concluded when fire or explosion occurred
 G- Other (Please explain): ____

7.3.3	TABLE: Propagation test (battery system)					N/A
Sample No.	OCV of Battery System Before Test, (V dc)	OCV of Target Cell Before Test, (Vdc)	Maximum Cell Case Temperature, (°C)	Maximum DUT Enclosure Temperature, (°C)	Results	
Method of cell failure ¹⁾		Location of target cell		Area for fire protection (m ²)		
Supplementary information:						
<p>1) Cell can be failed through applied heat, overcharge, nail penetration or combinations of these failures or other acceptable methods. See supporting documentation for details on cell failure method</p> <p>2) If the battery system has no outer covering, the manufacturer is required to specify the area for fire protection.</p> <p>Results:</p> <p>A – No fire external to DUT enclosure or area for fire protection or no battery case rupture</p> <p>B – Fire external to DUT enclosure or area for fire protection</p> <p>C – Explosion</p> <p>D – Battery case rupture</p> <p>E- Other (Please explain): ____</p>						

8.2.2	TABLE: Overcharge control of voltage (battery system)					P
Sample No.	OCV at start of test for Cell/Cell Blocks, (Vdc)	Maximum Charging Current, (A)	Max. Charging Voltage, (Vdc)	Max. Voltage of Cell/Cell Blocks, (Vdc)	Results	
A1	3.3	10.2	3.6	3.45	A, D	
			Charge Voltage Applied Battery System: 1)			
			Whole		Part	
					--	

Supplementary information:

1. The exceeded voltage can be applied to only a part of the system such as the cell(s) in the battery system per Figure 6 of IEC 62619, if it is difficult to do it in using the whole battery system.

Results:

A - No Fire or Explosion

B - Fire

C - Explosion

D - The voltage of the measured cells or cell blocks did not exceed the upper limit charging voltage

E - The voltage of the measured cells or cell blocks did exceed the upper limit charging voltage

F - All function of battery system did operate as intended during the test.

G - All function of battery system did not operate as intended during the test.

H - Other (Please explain): _____

8.2.3	TABLE: Overcharge control of current (battery system)				P
Sample No.	OCV at start of test, (Vdc)	Max. Charging Current, (A)	Max. Charging Voltage, (Vdc)	Results	
A2	3.2	10.8	3.7	A, D	

Supplementary information:

Results:

A - No fire or Explosion

B - Fire

C - Explosion

D - Overcurrent sensing function of BMU did operate and then charging stopped

E - Overcurrent sensing function of BMU did not operate and then charging stopped

F - All function of battery system did operate as intended during the test.

G - All function of battery system did not operate as intended during the test.

H - Other (Please explain): _____

8.2.4	TABLE: Overheating control (battery system)			P
Model No.	OCV at start(SOC 50%) of test, Vdc	Maximum Charging Current, A	Maximum Charging Voltage, Vdc	
A3	3.1	11.1	3.65	
Maximum Specified Temperature of Battery System, °C		Maximum Measured Cell Case Temperature, °C	Results	
58.9		59.0	A, D	
59.2		59.7	A, D	
59.7		59.9	A, D	
<p>Supplementary information:</p> <p>Results:</p> <p>A – No fire or Explosion</p> <p>B – Fire</p> <p>C – Explosion</p> <p>D - Temperature sensing function of BMU did operate and then charging stopped</p> <p>E - Temperature sensing function of BMU did not operate and then charging stopped</p> <p>F - All function of battery system did operate as intended during the test.</p> <p>G - All function of battery system did not operate as intended during the test.</p> <p>H - Other (Please explain): _____</p>				

List of test equipment used:

Clause	Measurement / testing	Testing / measuring equipment / material used, (Equipment ID)	Range used	Last Calibration date	Calibration due date
7.2.3.3	Digital multimeter	US-013	--	2021.08.26	2022.08.25
	Stop watch	US-358	--	2021.08.26	2022.08.25
8.2.2	Battery Testing System	US-372	--	2021.04.07	2022.04.06
	High precision battery detection system	US-414	--	2021.08.26	2022.08.25
	High precision battery detection system	US-415	--	2021.08.26	2022.08.25
	Digital multimeter	US-013	--	2021.08.26	2022.08.25
8.2.3	Battery Testing System	US-372	--	2021.04.07	2022.04.06
	High precision battery detection system	US-414	--	2021.08.26	2022.08.25
	High precision battery detection system	US-415	--	2021.08.26	2022.08.25
	Digital multimeter	US-013	--	2021.08.26	2022.08.25
8.2.4	Lithium battery pack energy feedback test system	US-520	--	2021.10.17	2022.10.16
	Digital multimeter	US-013	--	2021.08.26	2022.08.25
	Data acquisition	US-493	--	2021.08.26	2022.08.25
	Temperature recorder	US-138	--	2021.08.26	2022.08.25

Photo Documentation











