Product Service

Technical Report No.: 6121020040301

Date: 2020-06-29

Client:	Manta5 LP 18 Kaimiro Street, Pukete, Hamilton, 3200, New Zealand
Manufacturing place:	TD HiTech Energy Inc. No. 18-1, Guangfu North Road, Hukou Township, Hsinchu County, 30351, Taiwan
Test subject:	Product: Lithium Ion Battery Type: EA00001 (MT1007AA)
Test specification:	UN Manual of Tests and Criteria (ST/SG/AC.10/11/Rev.7) Section 38.3
Purpose of examination:	Test according to the test specification
Test result:	The samples has passed the test items of UN38.3

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1. Description of the test subject

1.1 Function

Manufacturer's specification for intended use:
This equipment is a Lithium Ion Battery which is used for Electric bicycle.

1.2 Consideration of the foreseeable use

☒ Not applicable
☐ Covered through the applied standard
☐ Covered by the following comment
☐ Covered by attached risk analysis

1.3 Technical Data

Nominal voltage (Vdc)	:	36 V
Nominal capacity (mAh, Wh)	:	23.45 Ah, 844 Wh
Weight	:	Approx. 5.433 kg

2. Order

2.1 Date of Purchase Order, Customer's Reference

2020-05-19

2.2 Receipt of Test Sample, Condition, Location

2020-05-25, TD HiTech Energy Inc.

2.3 Date of Testing 2020-05-28 to 2020-06-24

2.4 Location of Testing TD HiTech Energy Inc.
No. 18-1, Guangfu North Road, Hukou Township, Hsinchu County 30351, Taiwan

2.5 Points of Non-Compliance or Exceptions of the Test Procedure

None

3. Test Results

3.1 Positive Test Results

None

3.2 Points of Non-Compliance according to the test specification

No.	Name of Test Item	Standard requirement or The Clause Name os Standard	Test Rusult	Conclusion	Remark
1	Altitude Simulation	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.1	See Appendix 1	PASS	--
2	Thermal Test	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.2	See Appendix 2	PASS	--
3	Vibration	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.3	See Appendix 3	PASS	--
4	Shock	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.4	See Appendix 4	PASS	--
5	External Short Circuit	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.5	See Appendix 5	PASS	--
6	Overcharge	UN Manual of Testes and Criteria Section(7th) 38.3 Test T.7	See Appendix 6	PASS	--
Test Environment Condition		Ambient Temperature: 21.1~23.4 °C,Ambient Humidity: 51~64 %			

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Appendix 1

No.1	**Name of Test Items :T1**		**Test Item : Altitude Simulation Test**					
Test specification		Test cells and batteries shall be stored at a pressure of 11.6 kPa or less for at least six hours at ambient temperature (20 ± 5 °C).						
Judge criteria		Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.						
Sample No.	Sample Status	Test Before		Test After		Residual OCV/%	Mass Loss/%	Other Event	Result
		OCV /v	Weight /g	OCV /v	Weight /g				
1	First Cycle	41.46	5433	41.38	5433	0.19%	0.00%	O	Pass
2	First Cycle	41.46	5434.1	41.39	5434.1	0.17%	0.00%	O	Pass
3	First Cycle	41.44	5435.6	41.38	5435.6	0.14%	0.00%	O	Pass
4	First Cycle	41.44	5437.9	41.37	5437.9	0.17%	0.00%	O	Pass
7	25 Cycle	41.29	5442.7	41.24	5442.7	0.12%	0.00%	O	Pass
8	25 Cycle	40.10	5432.6	40.07	5432.6	0.07%	0.00%	O	Pass
9	25 Cycle	40.18	5434.6	40.14	5434.6	0.10%	0.00%	O	Pass
10	25 Cycle	40.51	5433.2	40.48	5433.2	0.07%	0.00%	O	Pass
Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire									

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Appendix 2

No.2	Name of Test Items :T2	Test Item : Thermal test
Test specification	Test cells and batteries are to be stored for at least six hours at a test temperature equal to 72± 2 °C, followed by storage for at least six hours at a test temperature equal to - 40 ± 2 °C. The maximum time interval between test temperature extremes is 30 minutes. This procedure is to be repeated until 10 total cycles are complete, after which all test cells and batteries are to be stored for 24 hours at ambient temperature (20 ± 5 °C). For large cells and batteries the duration of exposure to the test temperature extremes should be at least 12 hours	
Judge criteria	Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.	

Sample No.	Sample Status	Test Before		Test After		Residual OCV/%	Mass Loss/%	Other Event	Result
		OCV /v	Weight /g	OCV /v	Weight /g				
1	First Cycle	41.38	5433	40.68	5432.9	1.69%	0.01%	O	Pass
2	First Cycle	41.39	5434.1	40.69	5434	1.69%	0.00%	O	Pass
3	First Cycle	41.38	5435.6	40.69	5435.5	1.67%	0.00%	O	Pass
4	First Cycle	41.37	5437.9	40.68	5437.8	1.67%	0.00%	O	Pass
7	25 Cycle	41.24	5442.7	40.57	5442.6	1.62%	0.00%	O	Pass
8	25 Cycle	40.07	5432.6	39.40	5432.6	1.67%	0.00%	O	Pass
9	25 Cycle	40.14	5434.6	39.47	5434.6	1.67%	0.00%	O	Pass
10	25 Cycle	40.48	5433.2	39.81	5433.2	1.66%	0.00%	O	Pass

Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire

Appendix 3

No.3	Name of Test Items :T3	Test Item : Vibration Test
Test specification	Cells and batteries are firmly secured to the platform of the vibration machine without distorting the cells in such a manner as to faithfully transmit the vibration. The vibration shall be a sinusoidal waveform with a logarithmic sweep between 7 Hz and 200 Hz and back to 7 Hz traversed in 15 minutes. This cycle shall be repeated 12 times for a total of 3 hours for each of three mutually perpendicular mounting positions of the cell. One of the directions of vibration must be perpendicular to the terminal face. The logarithmic frequency sweep shall differ for cells and batteries with a gross mass of not more than 12 kg (cells and small batteries), and for batteries with a gross mass of more than 12 kg (large batteries). For cells and small batteries: from 7 Hz a peak acceleration of 1 gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1 6 mm total excursion) and the frequency increased until a peak acceleration of 8 gn occurs (approximately 50 Hz). A peak acceleration of 8 gn is then maintained until the frequency is increased to 200 Hz. For large batteries: from 7 Hz to a peak acceleration of 1 gn is maintained until 18 Hz is reached. The amplitude is then maintained at 0.8 mm (1.6 mm total excursion) and the frequency increased until a peak acceleration of 2 gn occurs (approximately 25 Hz). A peak acceleration of 2 gn is then maintained until the frequency is increased to 200 Hz.	
Judge criteria	Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire during the test and after the test and if the open circuit voltage of each test cell or battery directly after testing in its third perpendicular mounting position is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.	

Sample No.	Sample Status	Test Before		Test After		Residual OCV/%	Mass Loss/%	Other Event	Result
		OCV /v	Weight /g	OCV /v	Weight /g				
1	First Cycle	40.68	5432.9	39.86	5432.7	2.02%	0.00%	O	Pass
2	First Cycle	40.69	5434	39.84	5433.8	2.09%	0.00%	O	Pass
3	First Cycle	40.69	5435.5	39.91	5435.3	1.92%	0.00%	O	Pass
4	First Cycle	40.68	5437.8	39.59	5437.5	2.68%	0.01%	O	Pass
7	25 Cycle	40.57	5442.6	39.69	5442.3	2.17%	0.01%	O	Pass
8	25 Cycle	39.40	5432.6	38.52	5432.4	2.23%	0.00%	O	Pass
9	25 Cycle	39.47	5434.6	38.59	5434.2	2.23%	0.01%	O	Pass
10	25 Cycle	39.81	5433.2	38.93	5433.2	2.21%	0.00%	O	Pass
Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire									

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Appendix 4

No.4	Name of Test Items :T4	Test Item : Shock Test
Test specification	Test cells and batteries shall be secured to the testing machine by means of a rigid mount which will support all mounting surfaces of each test battery. Each cell shall be subjected to a half-sine shock of peak acceleration of 150 gn and pulse duration of 6 milliseconds. Alternatively, large cells may be subjected to a half-sine shock of peak acceleration of 50 gn and pulse duration of 11 milliseconds. Each battery shall be subjected to a half-sine shock of peak acceleration depending on the mass of the battery. The pulse duration shall be 6 milliseconds for small batteries and 11 milliseconds for large batteries. Each cell or battery shall be subjected to three shocks in the positive direction followed by three shocks in the negative direction of three mutually perpendicular mounting positions of the cell or battery for a total of 18 shocks.	
Judge criteria	Cells and batteries meet this requirement if there is no mass loss, no leakage, no venting, no disassembly, no rupture and no fire and if the open circuit voltage of each test cell or battery after testing is not less than 90% of its voltage immediately prior to this procedure. The requirement relating to voltage is not applicable to test cells and batteries at fully discharged states.	

Sample No.	Sample Status	Test Before		Test After		Residual OCV/%	Mass Loss/%	Other Event	Result
		OCV /v	Weight /g	OCV /v	Weight /g				
1	First Cycle	39.86	5432.7	39.84	5432.6	0.05%	0.00%	O	Pass
2	First Cycle	39.84	5433.8	39.82	5433.7	0.05%	0.00%	O	Pass
3	First Cycle	39.91	5435.3	39.89	5435.2	0.05%	0.00%	O	Pass
4	First Cycle	39.59	5437.5	39.54	5437.4	0.13%	0.00%	O	Pass
7	25 Cycle	39.69	5442.3	39.66	5442.2	0.08%	0.00%	O	Pass
8	25 Cycle	38.52	5432.4	38.48	5432.3	0.10%	0.00%	O	Pass
9	25 Cycle	38.59	5434.2	38.52	5434.1	0.18%	0.00%	O	Pass
10	25 Cycle	38.93	5433.2	38.89	5433.1	0.10%	0.00%	O	Pass

Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire

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Appendix 5

No.5	Name of Test Items :T5			Test Item : External Short Circui		
Test specification		Batteries are placed in to a 57±4℃ oven, and exterior packs temperature are monitored. When batteries exterior reach 57±4 ℃, they are shorted by connecting terminals with a copper wire of resistance less than 100m Ω. The short was continued for more than 1hour or the batteries temperature return to 57±4℃. The batteries are observed for a further 6 hours.				
Judge criteria		No rupture, no disassembly, no explosion, no fire, no smoke. Batteries exterior peak temperature <170℃.				
Sample No.	Sample Status	Open Circuit Voltage (V)	Measure External Resistance (mΩ)	External Highest Temperature (℃)	Other Event	Result
1	First Cycle	39.84	62.88	56.2	O	Pass
2	First Cycle	39.82	68.77	56.4	O	Pass
3	First Cycle	39.89	66.78	56.3	O	Pass
4	First Cycle	39.54	66.46	56.1	O	Pass
7	25 Cycle	39.66	63.48	55.6	O	Pass
8	25 Cycle	38.48	64.58	56.2	O	Pass
9	25 Cycle	38.52	63.66	55.3	O	Pass
10	25 Cycle	38.89	64.28	56.5	O	Pass
Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire						

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Appendix 6

No.6	Name of Test Items :T7	Test Item : Overcharge test
Test specification	The charge current shall be twice the manufacturer's recommended maximum continuous charge current. The minimum voltage of the test shall be as follows: (a) When the manufacturer's recommended charge voltage is not more than 18V, the minimum voltage of the test shall be the lesser of two times the maximum charge voltage of the battery or 22V. (b) When the manufacturer's recommended charge voltage is more than 18V, the minimum voltage of the test shall be 1.2 times the maximum charge voltage. Tests are to be conducted at ambient temperature. The duration of the test shall be 24 hours.	
Judge criteria	Rechargeable batteries meet this requirement if there is no disassembly and no fire during the test and within seven days after the test.	

Sample No.	Sample Status	OCV before Test	OCV after Test	Charge Voltage (V)	Charge Current (A)	Battery Pack Case Max. Temperature (℃)	Other Event	Result
9	First Cycle	41.46	41.64	50.4	16	20.11	O	Pass
10	First Cycle	41.46	41.72	50.4	16	21.42	O	Pass
11	First Cycle	41.44	41.68	50.4	16	22.35	O	Pass
12	First Cycle	41.44	41.67	50.4	16	22.25	O	Pass
13	25 Cycle	41.29	41.78	50.4	16	23.35	O	Pass
14	25 Cycle	41.46	41.75	50.4	16	23.74	O	Pass
15	25 Cycle	41.44	41.69	50.4	16	21.71	O	Pass
16	25 Cycle	41.44	41.73	50.4	16	22.11	O	Pass

Note:L-Leakage V-Venting D-Disassembly R-Rupture F-Fire O-No Leakage,No Venting,No Disassembly,No Rupture & No Fire

4. Remark

None

5. Documentation

- Making plate – see Appendix A
- Photo – see Appendix B
- Equipment List – see Appendix C

6. Summary

The test specification is met

TÜV SÜD Asia Ltd. Taiwan Branch

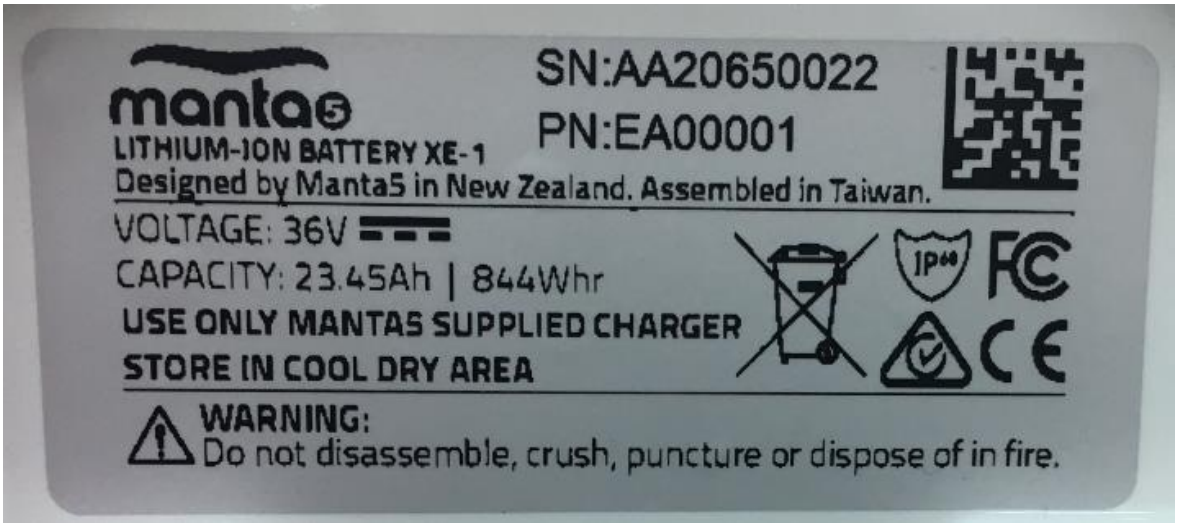
Project Handler by:

Mr. Jimmy Ting

Reviewe by:

Mr. Tony Hsu

Appendix A


manta5
LITHIUM-ION BATTERY XE-1
SN:AA20650022
PN:EA00001
Designed by Manta5 in New Zealand. Assembled in Taiwan.
VOLTAGE: 36V
CAPACITY: 23.45Ah | 844Whr
USE ONLY MANTA5 SUPPLIED CHARGER
STORE IN COOL DRY AREA
IP44
WARNING:
Do not disassemble, crush, puncture or dispose of in fire.

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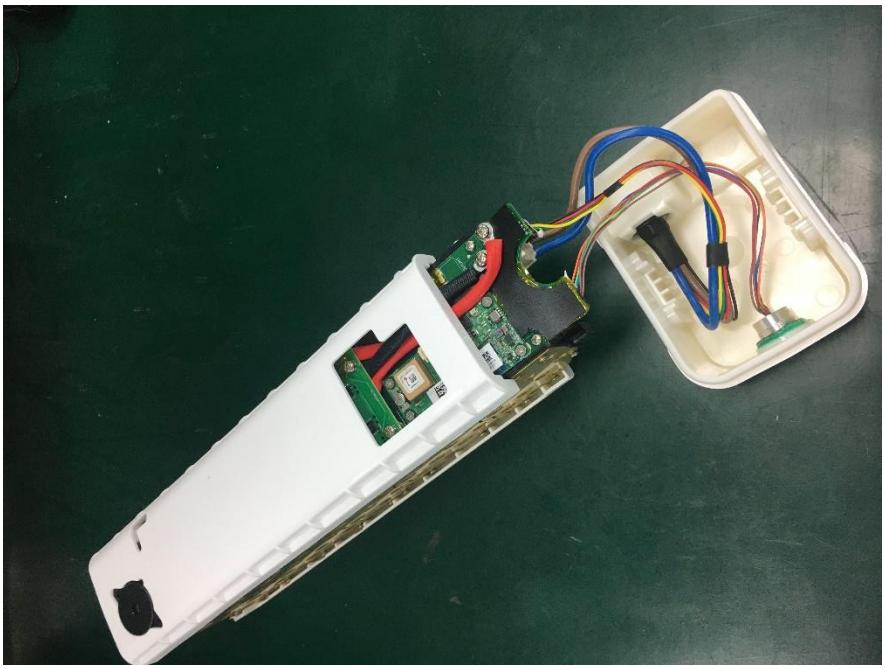
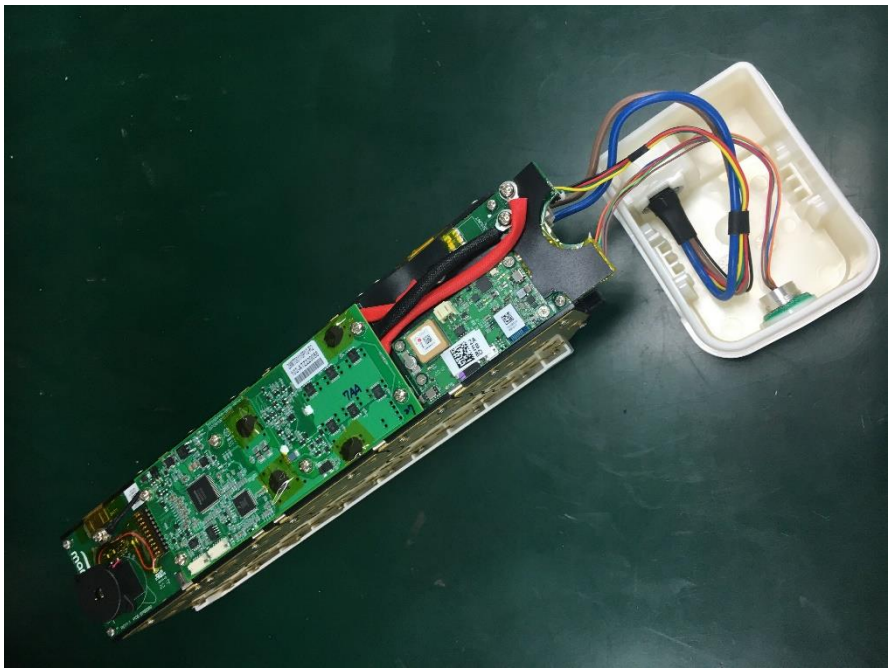
Appendix B





Appendix C

Equipment List:

Equipment name	Manufacturer	Model specifications	Machine code	Next Calibration
Altitude Simulation equipment	TERCHY	AT-125	980311	2021/06/19
Thermal equipment	King design industrial	KD-9709B	T-09-130310	2021/02/20
Vibration equipment _1500kgf	Shinken	G-0215NS	SG-4931	2021/02/26
Shock equipment	king design industrial	DP-1200-45	25107203198	2021/03/12
Chamber equipment	TERCHY	MCK-290	980306	2021/03/26
Power Supply equipment	Good Will Instrument Co	GW Instek GPR-10H10HHD	EL16A007	2021/11/13
Battery Testers, Resistance Meters	HIOKI	HIOKI BT3563	110602664	2021/04/11
Electronic scale	A&D Company	GX-12K	14902313	2021/06/09
Battery system test equipmen	Chen Tech Electric Mfg	MCF-60L4060A	D09126	2021/05/05 (for DCV)
				2021/02/11 (for DCA)
Battery system test equipmen	ACUTECH	ACUTECH BAT-720B	Battery system test equipmen	2021/02/11 (for DCV)
				2021/05/07 (for DCA)
Quartz Type Precision Thermohygrograph	ISUZU	TH-27R	0364786-115	2021/03/08