Lithium-ion Battery UN38.3 Test Report

Recommendations on the TRANSPORT OF DANGEROUS GOODS

(Manual of Tests and Criteria, Fifth revised edition, Amend.2)

Customer: Quanta
Model: SQU-1605
Rating: 15.4V , 2700mAh / 41.58Wh

Approved By	Checked By	Prepared By
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1. Purpose of the Test：

To test each cell/battery is of the type proved to meet the requirements in United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Fifth revised edition, Amend.2, Section 38.3.

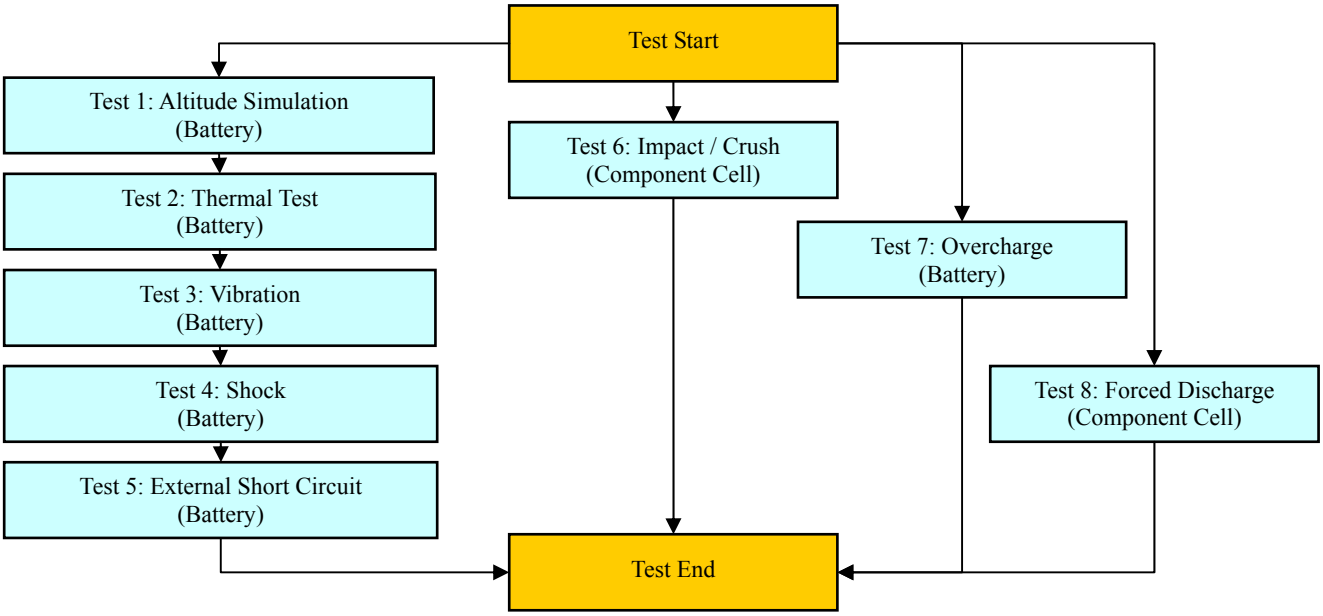
2. Test Quantity：

2.1 Four batteries, at first cycle, in fully charged states. (For T.1~T.5)
2.2 Four batteries, after 50 cycles ending in fully charged states. (For T.1~T.5)
2.3 Five component cells, at first cycle at 50% of the design rated capacity. (For T.6)
2.4 Four batteries, at first cycle, in fully charged states. (For T.7)
2.5 Four batteries, after 50 cycles ending in fully charged states. (For T.7)
2.6 Ten component cells, at first cycle in fully discharge states. (For T.8)
2.7 Ten component cells, after 50 cycles ending in fully discharged states. (For T.8)

3. Test Procedure：

3.1 All detailed test procedures must be based on United Nations Recommendations on the TRANSPORT OF DANGEROUS GOODS, Manual of Tests and Criteria, Fifth revised edition, Amend.2, Section 38.3.

3.2 Test flow shall be followed as below.



4. Test Result：

4.1 T.1 ~T.4 Test result: **Passed**

4.1.1 All batteries could meet the requirement of Table 38.3.1 Mass loss limit (M<1g: 0.5% ; 1g≦M≦75g: 0.2% ; M>75g: 0.1%) and residual OCV not less than 90% after the test.

4.1.2 No leakage, no venting, no disassembly, no rupture and no fire.

4.2 T.5 Test result: **Passed**

4.2.1 All batteries could meet the requirement, external temperature did not exceed 170℃.

4.2.2 All batteries were no disassembly, no rupture and no fire during the test and within six hours after the test.

4.3 T.6 Test result: **Passed**

4.3.1 All component cells could meet the requirement, external temperature did not exceed 170℃.

4.3.2 All component cells were no disassembly and no fire during the test and within six hours after the test.

4.4 T.7 Test result: **Passed**

4.4.1 All batteries could meet no disassembly and no fire during the test and within seven days after the test.

4.5 T.8 Test result: **Passed**

4.5.1 All component cells could meet the requirement, no disassembly and no fire during the test and within seven days after the test.

Conclusion: The samples had passed the test items of UN38.3.

5. Test Equipment：

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Revised Date: 2016-06-01

Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	Pretest							
V	ML-761	Learning	715C	0~18V 0~8A	SMP	2016/3/2	2017/3/2	
V	ML-762	Learning	715C	0~18V 0~8A	SMP	2016/1/6	2017/1/6	
V	ML-763	Learning	715C	0~18V 0~8A	SMP	2016/3/2	2017/3/2	
V	ML-764	Learning	715C	0~18V 0~8A	SMP	2016/1/6	2017/1/6	
	ML-838	Learning	PCP535	1.5V~5.5V 0~2.5A	SMP	2015/9/23	2016/9/23	
	T.1 Altitude Simulation							
V	ML-522	Altitude	SVT-120	Kpa:30~90	HSIN JIANG	2015/8/6	2016/8/6	
V	ML-257	Multimeter	HP 34401A	Note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1200 gf	CHUANHUA	2015/8/6	2016/8/6	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2015/9/23	2016/9/23	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2015/9/23	2016/9/23	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2015/9/24	2016/9/24	
	T.2 Thermal Test							
V	ML-789	Thermal Shock	GTST-080-65-AW	T:-40 to 120℃	GF	2016/1/6	2017/1/6	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2015/8/6	2016/8/6	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2015/9/23	2016/9/23	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2015/9/23	2016/9/23	
	T.3 Vibration							
V	ML-233	Vibration	KD-9636-EM-300F2K-30N80	F:5~2000Hz G:0.2~20G	King Design	2015/9/18	2016/9/18	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2015/8/6	2016/8/6	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2015/9/23	2016/9/23	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2015/9/23	2016/9/23	
V	ML-552	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2015/9/24	2016/9/24	
	T.4 Shock							
V	ML-056	Shock	DP-1200-25	G:10~600G	King Design	2015/9/18	2016/9/18	
V	ML-257	Multimeter	HP 34401A	note 1	Agilent	2016/3/4	2017/3/4	
	ML-494	Electronic Balance	XS1220M-SCS	1-1000 gf	CHUANHUA	2015/8/6	2016/8/6	
V	TD-166	Electronic Balance	PG603-S	1-610 gf	METTLER TOLEDO	2015/9/23	2016/9/23	
	ML-523	Electronic Balance	MTW-30K	30*0.005Kg		2015/9/23	2016/9/23	
V	ML-551	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2015/9/24	2016/9/24	
	T.5 External Short Circuit							
V	ML-534	mΩ Hitester	3540	1mΩ ~ 30kΩ	HIOKI	2015/9/25	2016/9/25	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	
V	ML-521	Oven	9031	30~80 ℃	YEOW LONG	2015/9/23	2016/9/23	
	T.6 Impact / Crush							
V	ML-339	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2016/5/19	2017/5/19	
	ML-076	Impact Tester			JYI SHENG	2016/1/6	2017/1/6	
	ML-553	Crush Tester	BCT-01		Simplo	2015/7/8	2016/7/8	
V	ML-866	Crush Tester	M0654		JYI SHENG	2016/4/28	2017/4/28	
	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	

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Test Instruments Reference List

Used	Instrument ID	Instrument Name	Type	Range of use	Manufacturer	Calibration Date_Last	Calibration Date_Next	Remarks
	T.7 Overcharge							
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2015/9/24	2016/9/24	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	
	T.8 Forced Discharge							
V	ML-132	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-133	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-136	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-192	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-269	Electronic Load	3311C	60V,55A, 300W	Prodigit	2016/3/4	2017/3/4	
V	ML-532	DC Electronic Load	33511-01	120V, 240A, 3600W	Prodigit	2015/8/6	2016/8/6	
V	ML-482	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-483	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-484	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-486	Programmable DC Source	DS10014	1-100Vdc, 0.3-14.4A	MOTECH	2016/5/19	2017/5/19	
V	ML-487	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-488	Programmable DC Source	DS6024	1-60 Vdc, 0.3-24A	MOTECH	2016/5/19	2017/5/19	
V	ML-550	Data Logger	313	15~35 ℃; 30~80 %RH	CENTER	2015/9/24	2016/9/24	
V	ML-459	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	
V	ML-460	Data Acquisition	MX100-E-1D	1-100 Vdc, -50 to 150℃	Yokogawa	2015/10/1	2016/10/1	

Note 1: DC Voltage: 0.1-1000V; AC Voltage: 0.5-700V at 60Hz, 1kHz; Resistance: 10Ω-10MΩ; DC Current: 0.1mA-3A; AC Current: 0.01-3A at 60Hz, 0.01-1A, at 1kHz.

6. T.1~T.8 Detail Reports:

UN 38.3 Test Datasheet

UN38.3/ST/SG/AC.10/11/Rev.5/Amend.2

Control Number: SQUU-1606001	Customer: Quanta	Model Name: SQU-1605	SMP Project Name: T99N
Pack P/N: 916T/QA088H (A)(B)	Configuration: 4S1P	Test Duration: 2016/04/29~2016/06/01	Reviewer: Esmond

Test Sample Identification: ☐ Large Battery ■ Small Battery ☐ Single-cell Battery

Battery Pack						Component Cell		
Used	Sample No.	Sample State	Used	Sample No.	Sample State	Used	Sample No.	Sample State
V	01~04	1 Cycle, Fully charged	V	05~08	50 Cycles, Fully charged	V	01C~05C	1 Cycle, 50% charged
V	09~12	1 Cycle, Fully charged	V	13~16	50 Cycles, Fully charged	V	06C~15C	1 Cycle, 0% discharged
		25Cycles, Fully charged			25 Cycles, Fully charged	V	16C~25C	50 Cycles, 0% discharged

T.1 Altitude Simulation

Start time: 2016/05/12 09:20						Ambient temp.: 23.8 ℃		Operator: Betty	
Finish time: 2016/05/12 15:40		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.462	17.468	17.459	17.463	17.457	17.468	17.461	17.455
	After	17.456	17.461	17.453	17.457	17.450	17.462	17.455	17.449
	Residual OCV %	99.97%	99.96%	99.97%	99.97%	99.96%	99.97%	99.97%	99.97%
Mass (g)	Before	181.537	181.368	181.472	181.674	181.367	181.723	181.458	181.559
	After	181.537	181.368	181.472	181.672	181.365	181.723	181.458	181.556
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

T.2 Thermal Test

Start time: 2016/05/12 16:10						Ambient temp.: 26.2 ℃		Operator: Betty	
Finish time: 2016/05/19 08:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.456	17.461	17.453	17.457	17.450	17.462	17.455	17.449
	After	17.198	17.189	17.173	17.183	17.174	17.195	17.189	17.193
	Residual OCV %	98.52%	98.44%	98.40%	98.43%	98.42%	98.47%	98.48%	98.53%
Mass (g)	Before	181.537	181.368	181.472	181.672	181.365	181.723	181.458	181.556
	After	181.520	181.342	181.442	181.655	181.338	181.702	181.435	181.529
	Mass loss %	0.01%	0.01%	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%
Results		P	P	P	P	P	P	P	P

T.3 Vibration

Start time: 2016/05/19 09:20						Ambient temp.: 23.7 ℃		Operator: Betty	
Finish time: 2016/05/20 11:50		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.198	17.189	17.173	17.183	17.174	17.195	17.189	17.193
	After	17.181	17.170	17.156	17.165	17.157	17.177	17.170	17.175
	Residual OCV %	99.90%	99.89%	99.90%	99.90%	99.90%	99.90%	99.89%	99.90%
Mass (g)	Before	181.520	181.342	181.442	181.655	181.338	181.702	181.435	181.529
	After	181.514	181.340	181.441	181.649	181.335	181.702	181.433	181.528
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

T.4 Shock

Start time: 2016/05/20 13:20						Ambient temp.: 24.6 ℃		Operator: Betty	
Finish time: 2016/05/20 15:20		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.180	17.169	17.155	17.165	17.157	17.176	17.169	17.174
	After	17.178	17.166	17.153	17.163	17.155	17.174	17.166	17.172
	Residual OCV %	99.99%	99.98%	99.99%	99.99%	99.99%	99.99%	99.98%	99.99%
Mass (g)	Before	181.514	181.340	181.441	181.649	181.335	181.702	181.433	181.528
	After	181.514	181.340	181.439	181.649	181.335	181.702	181.430	181.527
	Mass loss %	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Results		P	P	P	P	P	P	P	P

T.5 External Short Circuit

Start time: 2016/05/20 15:50						Ambient temp.: 24.4 ℃		Operator: Betty	
Finish time: 2016/05/23 09:00		Sample 01	Sample 02	Sample 03	Sample 04	Sample 05	Sample 06	Sample 07	Sample 08
OCV (V)	Before	17.178	17.166	17.153	17.163	17.155	17.174	17.166	17.172
	After	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Resistance (<100mΩ)		57.3	59.2	55.2	54.1	58.4	60.3	52.9	57.0
Max Temp. (< 170℃)		55.9	55.8	55.7	55.8	55.8	55.9	55.5	55.7
Results		P	P	P	P	P	P	P	P

T.6 Impact / Crush

UN38.3/ST/SG/AC.10/11/Rev.5/Amend.2

☐ Impact-Cylindrical cells not less than 18.0 mm in diameter

■ Crush- Prismatic, pouch, coin/button cells and cylindrical cells less than 18.0 mm in diameter

Start time: 2016/05/16 10:10				Ambient temp.: 24.2 ℃		Operator: Betty
Finish time: 2016/05/16 16:50	Sample 01C	Sample 02C	Sample 03C	Sample 04C	Sample 05C	
Initial OCV (V)	3.842	3.833	3.840	3.838	3.835	
Max Temp. (< 170℃)	25.3	24.5	24.8	24.6	25.1	
Results	P	P	P	P	P	

T.7 Overcharge

Start time: 2016/05/23 10:20					Ambient temp.: 24.3 ℃		Operator: Betty	
Finish time: 2016/06/01 15:00	Sample 09	Sample 10	Sample 11	Sample 12	Sample 13	Sample 14	Sample 15	Sample 16
Initial OCV (V)	17.459	17.465	17.460	17.464	17.462	17.467	17.465	17.459
Results	P	P	P	P	P	P	P	P

T.8 Forced Discharge

Start time: 2016/05/18 09:30					Ambient temp.: 24.3 ℃		Operator: Betty	
Finish time: 2016/05/25 18:00	Sample 06C	Sample 07C	Sample 08C	Sample 09C	Sample 10C	Sample 11C	Sample 12C	Sample 13C
Initial OCV (V)	3.426	3.431	3.421	3.418	3.429	3.424	3.432	3.417
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 14C	Sample 15C	Sample 16C	Sample 17C	Sample 18C	Sample 19C	Sample 20C	Sample 21C
Initial OCV (V)	3.432	3.423	3.416	3.433	3.425	3.419	3.429	3.424
Results	P	P	P	P	P	P	P	P
Sample No.	Sample 22C	Sample 23C	Sample 24C	Sample 25C				
Initial OCV (V)	3.428	3.422	3.430	3.427				
Results	P	P	P	P				

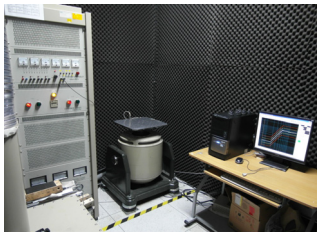
7. Equipment for Test:

Pretest

T.1 Altitude Simulation

T.2 Thermal Test

T.3 Vibration



T.4 Shock

T.5 External Short Circuit

T.6 Impact / Crush

T.7 Overcharge

T.8 Forced Discharge