

UN38.3 Test Summary

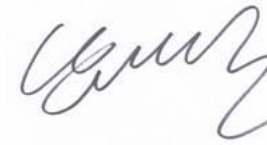
The following product has been evaluated according to the 6th revised edition of the UN Manual of Tests and Criteria.
We, LG Chem, Ltd., hereby certify that this battery meets the requirements of the regulation for transportation of lithium-ion cells, batteries and single cell batteries.

Manufacturer's contact information	LG Chem, Ltd. Address : 128 Yeoui-Daero, Yeongdeungpo-gu, SEOUL, 150-721, REPUBLIC OF KOREA Telephone : +82-10-7742-5427 E-mail : kkammy@lgchem.com Website : www.lgchem.com			
Test Laboratory information	LG Chem, Ltd. / RESEARCH PARK Address : 188 Munjiro, Yuseong-gu, Daejeon, 305-738, REPUBLIC OF KOREA Telephone : +82-10-4808-7362 E-mail : Milkis@lgchem.com Website : www.lgchem.com			
Description		List of Test Completed		
Test Report Number	QDI-190220-B-RESU10M	UN 38.3 Tests	Test 1. Altitude Simulation	Pass
Date of test report	2019. 02. 20		Test 2. Thermal Test	Pass
Item / Cell Type	Lithium ion Battery / Pouch		Test 3. Vibration	Pass
Model name	RESU10M		Test 4. Shock	Pass
Nominal voltage	77.7 V		Test 5. External Short Circuit	Pass
Capacity / Energy	63.0 Ah / 4.9 kWh		Test 6. Impact or Crush	Pass
Weight	Max 37.0 kg		Test 7. Overcharge	N/A
Dimensions	452(L)*418(W)*120(H) mm		Test 8. Forced Discharge	Pass

Reviewed By: MinJe Woo
Professional
Global Standard Certification Team
LG Chem, Ltd.
E-mail: Milkis@lgchem.com



Approved By: DaeHo Nam
Team Leader
Global Standard Certification Team
LG Chem, Ltd.
E-mail: kkammy@lgchem.com





LG Chem, Ltd.
128, Yeoui-daero, Yeongdeungpo-gu, Seoul, Korea
Global Standard Certification Team
Tel: 82-42-870-6195, Fax: 82-42-863-0182

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CERTIFICATE OF COMPLIANCE

The following product has been evaluated according to the 6th revised edition of the UN Manual of Tests and Criteria.

We, LG Chem, Ltd., hereby certify that this battery meets the requirements of the regulation for transportation of lithium-ion cells, batteries and single cell batteries.

<input type="checkbox"/> Lithium-ion cell <input checked="" type="checkbox"/> Lithium-ion battery <input type="checkbox"/> Lithium-ion single cell battery	
Model name	RESU 10M
Cell Model name	JH3
Nominal voltage	77.7 V
Electric power capacity	63 Ah

Reviewed By: MinJe Woo

Approved By: DaeHo Nam

Professional
Global Standard Certification Team
LG Chem, Ltd.
E-mail: milkis@lgchem.com

Team Leader
Global Standard Certification Team
LG Chem, Ltd.
E-mail: kkammy@lgchem.com

Document Number	QDI-190220-B-RESU 10M	
Prepared	MyeongHun Choi	<i>Choi</i>
Reviewed	MinJe Woo	<i>[Signature]</i>
Approved	DaeHo Nam	<i>[Signature]</i>

UN38.3 Test Report

- RESU 10M (63 Ah, 77.7 V) -

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2019. 02. 20



1. UN38.3 Large Battery Test Condition

Rev.6

Test item	Test Condition	Requirements	Etc.
Test 1. Altitude Simulation	Storing at (low pressure)11.6kPa for 6hr at 20+/-5°C		T1~T5 : Sequence Tests <pre> graph TD T1[Test 1 Altitude Simulation] --> T2[Test 2 Thermal Test] T2 --> T3[Test 3 Vibration] T3 --> T4[Test 4 Shock] T4 --> T5[Test 5 Ext. Short Circuit] </pre>
Test 2. Thermal Test	[72±2°C,12hr ↔ -40±2°C, 12hr,interval max. 30min] x 10cycle , Storing at 20±5°C for 24h		
Test 3. Vibration	[7Hz↔200Hz↔7Hz, in 15min] x 12 times x 3 direction 1) sinusoidal waveform with a logarithmic sweep 2) 7Hz~18Hz (maintaining 1gn) app. 50Hz (until 2gn) 200Hz (maintaining 2gn), 1.6mm total excursion	- After OCV (%) ≥ 90% - No leakage, no venting, no disassembly, no rupture, no fire - Mass loss limit (leakage) 1) If M < 1g, less than 0.5%, 2) If 1g ≤ M ≤ 75g, less than 0.2%, 3) If M > 75g, less than 0.1%	
Test 4. Shock	Half sine shock 1) Peak acceleration - For batteries (whichever is smaller) : 150gn or $\sqrt{\frac{30000}{Mass(kg)}}gn$ 2) Pulse duration : 6msec 3) 6 direction (±x, y, z) x 3 cycle		
Test 5. External Short Circuit	1) Samples to be heated to 57±4°C in chamber (Measured on external case) 2) Less than 0.1Ω, ext. short-circuit at 57±4°C 3) 1hr continue after returning to 57±4°C or "has decreased by half of the maximum temperature increase observed during the test and remains below that value" If this assessment is not feasible, the exposure time shall be at least 12hours	- No disassembly, no rupture, no fire within 6 hours after the test - Max. Temp ≤ 170°C	
Test 6. Impact	Φ=15.8±0.1mm bar, 9.1±0.1kg mass, 61±2.5cm height		for cylindrical cells (not less than 18mm diameter)
Test 6. Crush	Crushing rate :1.5cm/s, until 13kN±0.78kN or 100mV drop or 50% deformation	- No disassembly, no fire within 6 hours after the test - Max. Temp ≤ 170°C	for cylindrical cells (less than 18mm diameter) for prismatic, pouch, coin/button cells
Test 7. Overcharge	Current = Manufacturer's recommended max. continuous charge current X 2 Voltage 1.If charge voltage ≤ 18V, V (min.) = 2 x (max. charge voltage) or 22V. 2.If charge voltage > 18V, V (min.) = 1.2 x (max. charge voltage)	- No disassembly, no fire within 7 days after the test	Batteries not equipped with overcharge protection that are designed for use only in a battery assembly, which affords such protection, are not subject to the requirements of this test
Test 8. Forced Discharge	Discharge at max. discharge current (connecting in series with 12V DC power supply), Duration time = rated capacity/initial test current	- No disassembly, no fire within 7 days after the test	Resistance of Electric Loader $1/\Omega = (\text{max. discharge current}) / (12 + \text{Initial OCV})$

- Tests through T1-T5 shall be conducted in sequence with the same battery.
- Large battery means a lithium metal battery or lithium ion battery with a gross mass of more than 12 kg.

2-1. T1-T5 Test Result

Before			Altitude (T1)					Thermal (T2)					Vibration (T3)					Shock (T4)				
NO.	OCV	Mass (kg)	After OCV (V)	Mass (kg)	After OCV(%)	Mass Loss(%)	Result	After OCV (V)	Mass (kg)	After OCV(%)	Mass Loss(%)	Result	After OCV (V)	Mass (kg)	After OCV(%)	Mass Loss(%)	Result	After OCV (V)	Mass (kg)	After OCV(%)	Mass Loss(%)	Result

A. 1st cycle fully charged state

1	87.844	36.109	87.842	36.109	100.00	0.000	Pass	86.388	36.105	98.34	0.011	Pass	86.360	36.105	99.97	0.000	Pass	86.360	36.105	100.00	0.000	Pass
2	87.839	36.181	87.826	36.180	99.99	0.003	Pass	86.376	36.175	98.35	0.014	Pass	86.350	36.175	99.97	0.000	Pass	86.350	36.175	100.00	0.000	Pass

B. 25th cycle fully charged state

3	88.223	36.145	88.215	36.145	99.99	0.000	Pass	86.839	36.138	98.44	0.019	Pass	86.812	36.138	99.97	0.000	Pass	86.812	36.138	100.00	0.000	Pass
4	88.091	36.146	88.087	36.146	100.00	0.000	Pass	86.811	36.141	98.55	0.014	Pass	86.781	36.141	99.97	0.000	Pass	86.781	36.141	100.00	0.000	Pass

EXT.Short Circuit (T5)			
NO.	Initial OCV(V)	Max. Temp (°C)	Result

A. 1st cycle fully charged state

1	86.360	56.00	Pass
2	86.350	57.00	Pass

B. 25th cycle fully charged state

3	86.812	57.00	Pass
4	86.781	56.65	Pass

2-2. T6/T8 Test Result (JH3)

Crush (T6)			
NO.	Initial OCV(V)	Max. Temp (°C)	Result

A. 1st cycle 50% charged state

C-1	3.718	23.54	Pass
C-2	3.720	23.96	Pass
C-3	3.721	24.05	Pass
C-4	3.720	25.08	Pass
C-5	3.719	23.28	Pass

Forced Discharge (T8)							
NO.	Initial OCV(V)	Max. Temp (°C)	Result	NO.	Initial OCV(V)	Max. Temp (°C)	Result

A. 1st cycle fully discharged state

C-6	3.362	58.40	Pass
C-7	3.368	61.20	Pass
C-8	3.204	57.70	Pass
C-9	3.392	59.60	Pass
C-10	3.385	61.60	Pass
C-11	3.373	61.70	Pass
C-12	3.269	60.00	Pass
C-13	3.390	57.70	Pass
C-14	3.381	62.10	Pass
C-15	3.389	60.60	Pass

B. 50th cycle fully discharged state

C-16	3.196	64.30	Pass
C-17	3.342	63.50	Pass
C-18	3.367	61.90	Pass
C-19	3.342	67.40	Pass
C-20	3.162	67.60	Pass
C-21	3.352	66.20	Pass
C-22	3.354	60.40	Pass
C-23	3.371	61.10	Pass
C-24	3.163	60.30	Pass
C-25	3.356	65.90	Pass

3. Sample Image

