Approval Sheet

Lithium-Ion Rechargeable Battery

Attend to: UPERGY

Product: ☑ Cell ☐ Pack

Model: ICP103450CA

Doc #: ICP103450CA-04 Rev.: 3.0

Date: 6/8/2021

Accepted by Customer	
Title:	
Signature: (Date)	

E-One Moli Energy Corp.				
Approved by (Date)	**Check by** (Date)	**Check by** (Date)	**Check by** (Date)	**Originator** (Date)

TABLE OF CONTENTS

1. SCOPE

This specification defines the characteristics of a lithium ion rechargeable cell, ICP103450CA, 2.0 Ah, designed and manufactured by E-One Moli Energy Corp.

2. PRODUCT DESCRIPTION

2.1 Cell Name

Lithium ion rechargeable cell ('cell')

2.2 Cell Model

ICP103450CA

2.3 Cell designation: ICP11/34/50

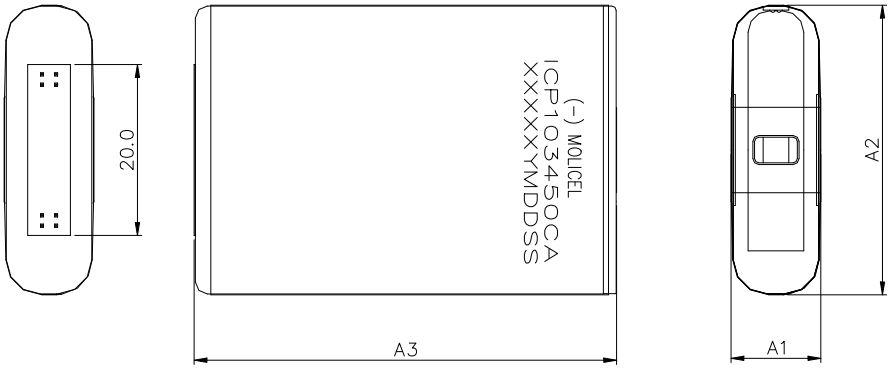
2.4 Cell Construction

2.4.1 Shape: Prismatic

2.4.2 Outline Dimensions (refer to 2.4.3 finished cell drawing)

Outline Dimensions (mm)			Weight (g)
Thickness [A1]	Width [A2]	Height [A3]	
10.6 +0.3/-0.3	33.8 +0.2/-0.2	49.5 +0.5/-0.5	41.5 (Max)

2.4.3 Finished Cell Drawing



Cell Date Code: YMDDSS

Y: indicates calendar year, 9=2009, A=2010, B=2011, C=2012, D=2013, E=2014, etc.

M: indicates calendar month, 1~9, 10=A, 11=B, 12=C.

DD: indicates calendar date of a month, 01~31.

SS: indicates the sequence number in a day, 01, 02, etc..

3. APPEARANCE

There shall be no visual defects such as dent, rust, deformation or leakage.

4. RATED SPECIFICATIONS

	Items		Specifications		Remarks
1a	Rated charge		Limiting 1.9A and constant 4.2V charge for 3 hours at 23 °C.		
1b	Recommended charge		Limiting 1.33A and constant 4.2V charge for 3hours at 23 °C.		
2	Rated discharge		Constant 0.38A discharge until 3.0V at 23 °C.		
3	Rated capacity		1.96Ah (Typical) 1.90Ah (Minimum)		Rated discharge capacity after rated charge.
4	Nominal voltage		3.70V		Mean voltage during rated discharge after rated charge.
5	Shipping voltage		≥ 3.75V		Nominal approximate state of charge ≤ 30%.
6	Internal resistance		≤ 75mΩ		By AC Impedance 1kHz
7	End of charge voltage		4.20 ± 0.05V		
8	End of discharge voltage		3.0 V		
9	Charging time		3 hours		Recommended charge.
10	Maximum continuous charging current		1.9A		Present UL approval level.
	Maximum continuous discharging current		≤ 45 °C	2.5A	Maximum permitted discharge current to avoid activation of thermal fuse
			≤ 60 °C	2.0A	
11	Operating temperature	Charging	0~45 °C		
		Discharging	-20~60 °C		
12	Storage temperature for shipping cell		<35 °C		Recommended temperature less than 23 °C for long term storage.
13	Shelf life		1 year		See section 5.4

5. PERFORMANCE

5.1 Standard Test Conditions

5.1.1 Tolerance on temperatures is ±2 °C. All tests performed at a relative humidity between 45% and 85% unless noted otherwise.

5.1.2 3 hours minimum soak time at specified temperature prior to discharging.

5.1.3 The accuracy of measuring equipments (voltmeter and ammeter, etc.) shall be higher than class 0.5 in the tests.

5.1.4 Standard cycling: 1.33A charge to 4.2V for 3hours and 1.9A discharge to 3.0V, rest 10 minutes between charge and discharge.

5.1.5 0.5C Cycling: 1.33A charge to 4.2V for 3hours and 0.95A discharge to 3.0V, rest 10 minutes between charge and discharge.

5.1.6 For incoming inspection purpose, the cells should be used in the tests within one week of receipt at customer.

5.2 Electrical Performance

Items		Condition	Criterion	Test Method
1	Discharge Capacity at 23 °C	1.90A	≥1.77Ah	Discharge capacity to 3.0V after recommended charge (4.1b).
		0.95A	≥1.85Ah	Discharge capacity to 3.0V after recommended charge (4.1b).
		0.38A	≥1.90Ah	Minimum rated capacity. Discharge capacity to 3V after recommended charge (4.1b).
2	Temperature Discharge Capacity at 0.38A	60 °C	≥1.88Ah	Discharge capacity to 3.0V after recommended charge (4.1b).
		45 °C	≥1.88Ah	Discharge capacity to 3.0V after recommended charge (4.1b).
		0 °C	≥1.70Ah	Discharge capacity to 3.0V after recommended charge (4.1b).
		-10 °C	≥1.47Ah	Discharge capacity to 3.0V after recommended charge (4.1b).

5.3 Cycle Life

Item	Conditions		Criterion	Test Method
1	23ºC 1.90A	C300	≥70%	Per 5.1.4, standard cycling at 23ºC to 300 cycles. The % = (Ah / 1.77) x 100%
2	23ºC 0.95A	C300	≥70%	Per 5.1.5, 0.5C cycling at 23ºC to 300 cycles. The % = (Ah / 1.85) x 100%

5.4 Storage Performance (SOC: State of Charge)

Item	Conditions		Capacity retention	Test Method
1	60 ºC 1 week	100% SOC	≥90%	After storage, rated discharge (4.2) and recommended charge (4.1b) for two cycles. The retention capacity (Ah) is defined at 1st discharge after storage. The % = (Ah / 1.9) x 100%
2	23 ºC 1 month	30% SOC	≥28%	
3	23 ºC 3 months	30% SOC	≥26%	
4	23 ºC 6 months	30% SOC	≥23%	
5	23 ºC 1 year	30% SOC	≥20%	

5.5 Safety Performance

5.5.1 Environmental Endurance Performance

Items		Criteria	Conditions
1	Heating	No fire or explosion	At 100% SOC heat cell up in gravity convection and/or circulating air oven. Oven temperature is to be raised at a rate of 5ºC (± 2ºC) per minute to a temperature of 150ºC (± 2ºC). Hold oven at 150°C for 10 minutes.
2	Thermal Test	Mass loss <0.1%, No leakage, venting,	6 Hours @ 75 ± 2°C followed by 6 Hours @ -40 ± 2°C x 10 Cycles (interval time of no more than 30

		explosion, fire, disassembly, or rupture.	minutes between temperatures). Measurements taken after 10 cycles and 24 hours storage at 20± 5°C. (UN method)

5.5.2 Electrical Endurance Performance

	Items	Criteria	Conditions
1	Short Circuit	No disassembly, rupture or fire within 6 hours of test. Max temp: < 150°C.	While in preheated oven and cell temperature reaches 57 ± 4°C, short circuit cell using a total external resistance < 0.1 ohm until cell temperature has returned to 57 ± 4°C. (UN method)
2	Forced Discharge	No disassembly and no fire within 7 days of test	Connect cell in series with a 12V DC power supply at a current equal to maximum discharge specified. (UN method)
3	Overcharge	No fire or explosion	Charging at a current of 5.7A to 4.55V from the fully discharged state for 7hrs.

5.5.3 Mechanical Endurance Performance

	Items	Criteria	Conditions
1	Crush	No fire or explosion	Crush between two flat plates on the flat surface of the cell. Applied force is about 13KN.
2	Impact	No fire or explosion	Impact by 15.8mmφ bar with 9.1kg weight dropped from 61cm height on the flat surface.

5.6 Environmental Reliability

	Items	Criteria	Conditions
1	Shock	No leakage, mass loss, no venting, disassembly, no rupture and no fire. 90% voltage recovery	Subject to 6 shocks/axis, 18 total, of peak acceleration of 150g and pulse duration of 6 ms. (UN method)
2	High Temperature/ Humidity	No leakage, no vent, no fire or explosion	Store cell at 70°C, 90% relative humidity for 88 hours.

	Storage		
3	Drop	No visible electrolyte leakage, no temperature rising.	Drop from a height of 4 ft onto a flat surface of wooden floor (Pine or other types of wood having equivalent hardness) three times for each side of the cell.(total number of drops=9)
4	Vibration	No leakage, mass loss, no venting, disassembly, no rupture and no fire. 90% voltage recovery	Subject to 7↔200Hz / 15 min vibration, 12x15 min /3 axes at amplitude of 0.8mm (1.6 mm total excursion). (UN method)
5	High Altitude Exposure	No leakage, weight loss, no vent, fire or explosion, 90% voltage recovery	Stored at a pressure of 11.6 kPa for 6 hrs at 20°C. (UN method)

6. REGULATORY COMPLIANCE

6.1 UL 1642 recognized component.

6.2 Comply with UN Recommendations on the Transport of Dangerous Goods: Manual of Tests and Criteria.

6.3 Comply with EU RoHS (The Restriction of the use of certain Hazardous Substances in electrical and electronic equipment, Directive 2015/863/EU).

6.4 Comply with IEC62133.

7. PRECAUTIONS FOR USING LITHIUM ION RECHARGEABLE CELL

The precautions described below are important to assure the performance and safety of designed pack. Mishandling may cause cell leakage, heat, smoke, explosion or fire. Please follow instructions carefully.

7.1 Intended Use

Notebook, DSC, PDA, MP3 player, Personal medical player, Personal medical player, Portable game player, HID handy flash, Walky-talky.

7.2 Handling Precautions

7.2.1 Charging

The lithium ion rechargeable cell is to be charged by “constant current/constant voltage” method. The lithium ion cell is charged at a constant current (CC Mode) until the cell voltage reaches 4.2 V, followed by a constant voltage charge (CV Mode) at 4.2 V. The charging current at this constant voltage tapers off. As long as the tapering current is down to 2% of 1C rate current or the charging time at CV Mode reaches 1.5 hours (whichever comes first); the charge process is deemed complete.

1) Charge voltage:
   Do not exceed the specified charge voltage (4.2V per single cell). If the cells are used in battery packs, the maximum voltage is 4.2 x N (N= number of cells connected in series) V.
2) Charge current:
   Charge the cell at the specified charge current listed in section 4.10 or less..
3) Charge temperature:
   Charge the cell at the temperature range of 0 °C ~ 45 °C. Due consideration should also be given to the arrangement of the battery pack so that it is in that temperature range even though it is effected by heat generated from the cell charger.

7.2.2 Reverse charging:

The cell must be prevented from reverse-polarity charging.

7.2.3 Discharging

A lithium ion rechargeable cell starts to discharge at 4.2V and terminates at a cut off voltage of 3.0V.

1) Discharge current:
   Discharge the cell at the specified discharge current listed in section 4.10 or less. In case a peak current of higher than maximum discharge current depending on the pulse interval may reduce the cell capacity or activate thermal fuse.
2) Discharge temperature:
   Discharge the cell at temperature range from –20°C to 60°C. At a temperature of –20°C or less, the cell will show a significant decrease in discharge capacity.

3) Discharge termination voltage/Over discharge:
Avoid discharge to voltage less than 3.0V per single cell. A leakage current to the equipment may over discharge the cell, which may damage the performance of cell.

7.2.4 Long-term Storage

1) In case of long-term storage, store the cell at <23 °C, low humidity, noncorrosive gas atmosphere.
2) The cell voltage should be maintained at greater than 3.0V. Should the cell voltage approach to 3.0V (0%SOC) it is recommended that the cell be charged back up to 30% capacity.
3) Do not store cell in humid environment.

7.3 Safety Precautions

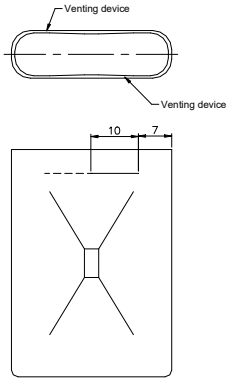
7.3.1 When using the cell

ⓘWARNING

1) Mishandling of a cell can lead to generation of heat, possible explosion or ignition and potential serious injury. Safe handling guidelines include the following:
   (1) Do not solder directly onto the cell.
   (2) Do not expose cell to fire or heat.
   (3) Do not install the cell backwards.
   (4) Do not expose the cell to water or salt water, or allow the cell to get wet.
   (5) Do not carry or store the cells together with necklaces, hairpins or other metal objects.
   (6) Do not place the cells in microwave ovens, high-pressure containers, or on induction cookware.
   (7) Do not connect the positive terminal and the negative terminal of the cell to each other with any metal objects such as chains, coins or wire.
   (8) Do not pierce the cell with nails, strike the cell with a hammer, step on the cell, or otherwise subject it to strong impacts or shocks.
2) Do not disassemble or modify the cell. The cell contains safety and protection devices, that if damaged, may cause the cell to generate heat, explode or ignite.
3) Do not place the cell in or near fire, stoves, or other high-temperature

locations. Do not place the cell in direct sunshine or use or store the cell inside cars in hot weather. Doing so may cause the cell to generate heat, explode, or ignite. Using the cell in this manner may also result in a loss of performance and a shortened life expectancy.

4) Venting device description
Safety Valve: Allowing controlled release of pressure in the event of excessive internal gas build up.



ⓘ CAUTION

1) If the device is to be used by small children, the caregiver should explain the contents of the user's manual to the children. The caregiver should provide adequate supervision to ensure that the device is being used as explained in the user's manual.
2) When the cell is worn out, insulate the terminals with adhesive tape or similar materials before disposal.
3) Immediately discontinue use of the cell if, while using, charging, or storing the cell, the cell emits an unusual smell, feels hot, changes color, changes shape, or appears abnormal in any other way. Contact your sales location or E-One Moli Energy if any of these problems are observed.
4) In the event that the cell leaks and the fluid gets into one's eye, do not rub the eye. Rinse well with water and immediately seek medical care. If left untreated the cell fluid could cause damage to the eye.

7.3.2 When charging the cell

ⓘWARNING

1) Be sure to follow the rules listed below while charging the cell. Failure to do

so may cause the cell to become hot, explode, or ignite and cause serious injury.

(1) Do not attach the cell to a power supply plug or directly to a car's cigarette lighter plug.

(2) When charging the cell, use a specified cell charger or ensure that the cell charging conditions specified by E-One Moli Energy are met.

(3) Do not place the cells in or near fire, or into direct sunlight. When the cell becomes hot, the built in safety equipment is activated, preventing the cell from charging further, and heating the cell can destroy the safety equipment and can cause additional heating, breaking, or ignition of the cell.

2) Do not continue charging the cell if it does not recharge within the specified charging time. Doing so may cause the cell to become hot, explode, or ignite.

ⓘ CAUTION

3) The temperature range over which the cell can be charged is 0 °C to 45 °C. Charging the cell at temperatures outside of this range may cause the cell to become hot or malfunction. Charging the cell outside of this temperature range may also harm the performance of the cell or reduce the cell's life expectancy.

7.3.3 When Discharging the Cell

ⓘWARNING

1) Do not discharge the cell using any device except for the specified device. When the cell is used in unspecified devices it may damage the performance of the cell or reduce its life expectancy, and if the device causes an abnormal current to flow, it may cause the cell to become hot, explode, or ignite and cause serious injury.

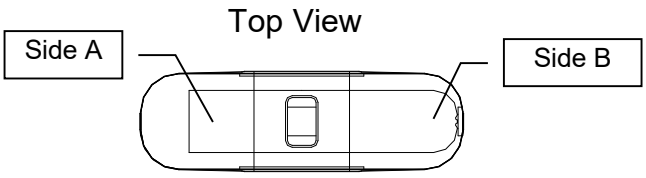
ⓘ CAUTION

2) The temperature range over which the cell can be discharged is –20°C to 60°C (Consult E-One Moli Energy if you plan to discharge the cells at temperature less than –20°C. Use of the cell outside of this temperature range may damage the performance of the cell or may reduce its life

expectancy.

7.4 Post-Assembly Precautions

7.4.1 A built-in thermal fuse is designed under the side A as shown in below. Thermal fuse is used to prevent any abusive over-current and over-temperature. The typical fusing-off temperature is around 89-98°C. The operation of tab and cell welding as well as tab/wire soldering may have potential risk to activate the fuse. Do NOT weld directly on side A, please weld on the side B.



7.4.2 Avoid excessive force on the cell terminals and prevent sparking during welding.

7.4.3 Use same date code cells within a battery pack. The date code is on the master carton.

7.4.4 Do NOT mix different cell types or manufacturers within a battery pack.

7.4.5 Do NOT over-stress or rotate at positive terminal. It is possible to cause over-stress by removing the welding point.

7.4.6 All battery packs should be inspected for voltage, impedance, and function of protection circuit prior to shipment.

7.4.7 Do NOT assemble damaged cells into packs.

7.4.8 If the cells are re-shipped to assembling manufacturer, package carefully into the original shipping boxes.

7.5 Disposal Instructions

When disposing of secondary cells or batteries, keep cells or batteries of different electrochemical systems separate from each other.

8. REQUIREMENT FOR BATTERY PACK DESDIGN

E-One Moli Energy recommends that cells be assembled in a pack with protection circuit. Various protection circuit modules are available for applications of multiple series and parallel

configurations. In order to ensure safe use of cell, be sure to consult with E-One Moli Energy regarding charging and discharging specifications and contact E-One Moli Energy in advance when designing a device with this cell.

8.1 Protective circuit function recommendations:

8.1.1 Overcharge protection: recommend overcharge voltage under 4.3V/cell within a tolerance 0.05/cell maximum. The voltage tolerance is better under 0.03V/cell. The charge current shall be shut down once overcharge protection function working.

8.1.2 Over discharge protection: recommend over discharge voltage range 2.2~3.0V/cell. Below this level the discharge current shall be shut down and the consumption current should be below 10uA.

8.1.3 Over discharge current protection: For multi-cell application, the over-current protective device (PTC or thermal fuse) is NEEDED. The discharge current shall be shut down once discharge current exceeds 2.5A/cell.

8.1.4 Over temperature protection: The battery should have over temperature warning system. The battery shall control FET directly and stop charge/discharge once cell over temperature.

8.2 Battery position: To prevent degradation of battery performance by heat exposure, battery shall be positioned away from heat generating source inside application equipment and charger.

8.3 Cell connection: To avoid damage, Do NOT solder onto a cell. Weld spot welding lead onto cell, and then solder lead wire. B+ and B- wire connection should not be crossed with each other.

8.4 Cell configuration: An isolation design that involves a plastic barrier or non-thermal conductive material between cell and PCBA is recommended.

8.5 Cell voltage monitoring: The battery should be equipped to monitor each cell voltage. The battery shall stop charging once cell imbalance is detected.

9. WARRANTY OF CELL

Warranty period is one year after shipment under normal conditions. Within this period, E-One Moli Energy will replace the cell for free against defects as long as it is confirmed such defects are the failure of the cell manufacturing process. Any other defects caused by pack assembly equipment/system malfunction or abnormal usage of the cell are not covered by this warranty.

10. SHIPPING STATE OF CELL

The cell is shipped at a state of charge not to exceed 30% of rated capacity. Less than 35 ºC is recommended for cell shipping during transportation.

11. PACKING SPECIFICATION

The maximum quantity of the cells in a box is 190pcs.

12. AMENDMENT OF SPECIFICATION CONTENT

This specification stipulates the final and comprehensive characteristics of the product. It is the responsibility of the customer to explicitly disclose in writing any additional requirements to E-One Moli Energy prior to agreement of purchase.