

# Safety Guidelines

## Handling instructions



### Preventing Quality Problems

To prevent the batteries of being discharged please observe the following rules.

1. Do not place batteries on a conductive surface (anti-static work mat, packaging bag or form trays) as it can cause the battery to short.
2. Remove the batteries from the transport tray one at a time (do not throw batteries randomly by turning over trays)
3. Please make sure that batteries can't touch each other while handling them.

### Safety Guidelines and Precautions

Please observe the following warnings strictly. If misused, the batteries may explode or leak, causing injury or damage to the equipment.

1. Keep batteries out of the reach of children, especially those batteries fitting within the limits of the truncated cylinder defined in ISO/DP 8124/2.2 page 17. In case of ingestion of a cell or battery, the person involved should seek medical assistance promptly.
2. Equipment intended for use by children should have battery compartments which are tamper-proof.
3. The circuits of equipment designed to use alternative power should be such as to eliminate the possibility of the battery being overcharged

(see UL standard for diode use).

4. The batteries must be inserted into the equipment with the correct polarity (+ and -).
5. Do not attempt to revive used batteries by heating, charging or other means.
6. Do not dispose of batteries in fire. Do not dismantle batteries.
7. Replace all batteries of a set at the same time. Newly purchased batteries should not be mixed with partially exhausted ones. Batteries of different electrochemical systems, grades or brands should not be mixed. Failure to observe these precautions may result in some batteries in a set being driven beyond their normal exhaustion point and thus increase the possibility of leakage.
8. Do not short-circuit batteries.
9. Avoid directly soldering to batteries.
10. Do not expose batteries to high temperatures, moisture or direct sunlight.
11. When discarding batteries with solder tags, insulate the tags by wrapping them with insulating tape.
12. Improper welding can damage the internal components of batteries and impair their performance.

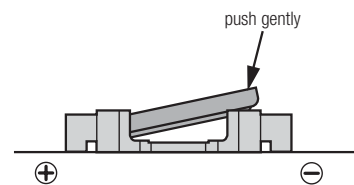
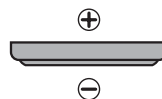
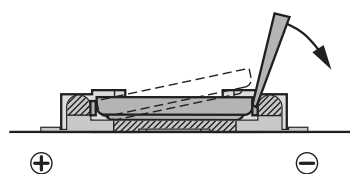
### Correct replacement of a coin cell

Renata's horizontal SMT and through-hole battery holders are made of heat resistant, glass fibre filled Liquid Crystal Polymer (LCP).

Despite the excellent characteristics of this holder material, it can happen that a holder is damaged

when trying to replace a coin cell in an inappropriate manner.

In order to minimize such risk of damage, please replace the coin cell as demonstrated in the pictures below:



# Safety Guidelines

## Underwriters Laboratories' (UL) Safety Approval



### Introduction

#### Safety Approval of RENATA LITHIUM Products



#### Underwriters Laboratories Inc. Northbrook / IL / USA

Recognition covers under the file number MH14002 the following Renata Lithium products:

#### Button cells

CR1025, CR1216, CR1220, CR1225, CR1616, CR1620, CR1632, CR2016, CR2016 MFR, CR2025, CR2025 MFR, CR2032, CR2032 MFR, CR2320, CR2325, CR2430, CR2450N, CR2477N.

These cells may have an additional two letter suffix which denotes type of solder tab or wire lead, or the mode of packaging or an additional letter and three digits suffix which denotes type of solder tab or wire lead.

#### Power modules

With Decoupling Diodes	Without Decoupling Diodes
1000-1	1000-0
1000-1B	1000-0B
	338A

### Conditions of Acceptability

The use of these cells may be considered generally acceptable under the conditions given below:

1. The cells are identified in accordance with "Marking" as described below.
2. Unless the conditions of Par. 2A are met, these batteries are to be used only in devices where servicing of the battery circuit and replacement of the lithium battery will be done by a trained technician.

2A. All of these batteries are acceptable for use in user-replaceable applications when used in accordance with the following except for Model CR2477N:

2A.1 The end product must be designed to prevent reverse polarity installation of the battery, or if the battery is reversed, the short- or open circuiting of any protective component, one component at a time, shall not result in forced-discharge of the battery.

2A.2 The end product shall contain a warning notice adjacent to the battery stating the following: "Replace Battery With (Battery Manufacturer's Name or End-Product Manufacturer's Name), Part No. ( ) Only. Use of another battery may present a risk of fire or explosion. See owner's manual for safety instructions".

2A.3 The instruction manual supplied with the end product shall also contain the above warning notice along with instructions to the user as to where replacement batteries can be obtained. The instruction manual shall also contain the following additional warning notice: **"WARNING, Battery may explode if mistreated. Do not recharge, disassemble or dispose of in fire."**

3. These cells are intended for use at ordinary temperatures where anticipated high temperature excursions are not expected to exceed 100°C (212°F).

4. These cells can be used in series up to a maximum of four cells of the same model number. When used in series, there should be instructions adjacent to the cells stating that when the cells are replaced, they should all be replaced at the same time using fresh cells only. These cells should not be connected in series with any other (other than the allowed number of cells in series) power source that would increase the forward current through the cells.

5. The circuit for these cells shall include one of the following:

A) Two suitable diodes or the equivalent in series with the cells to prevent any reverse (charging) current. The second diode is used to provide protection in the event that one should fail. Quality control, or equivalent procedures, shall be

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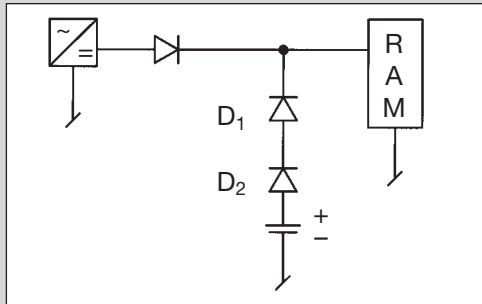
## Underwriters Laboratories' (UL) Safety Approval



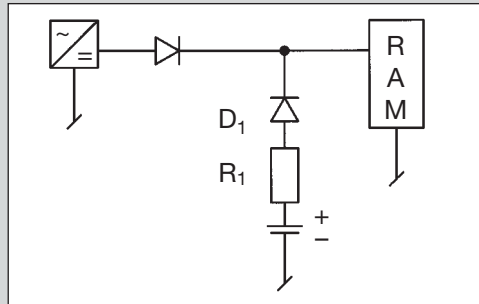
established by the device manufacturer to insure the diode polarity is correct for each unit, or

B) A blocking diode or the equivalent to prevent reverse (charging) current, and in the event of

diode failure, the cells shall be further protected against reverse (charging) current in excess of the values shown below. The measurement of this current shall include appropriate abnormal tests.



When  $D_1$  is shorted  $D_2$  still protects battery against recharging.



$R_1$  limits the recharging current when  $D_1$  fails.

**Note:** An additional voltage drop over  $D_2$  or  $R_2$  must be considered when battery is operating.

Model No.	Max. Abnormal Charging Current (mA)	User replaceable
CR1025	5.0	Yes
CR1216	5.0	Yes
CR1220	25	Yes
CR1225	25	Yes
CR1616	25	Yes
CR1620	25	Yes
CR1632	25	Yes
CR2016 MFR	10	Yes
CR2016	25	Yes
CR2025 MFR	10	Yes
CR2025	25	Yes

Model No.	Max. Abnormal Charging Current (mA)	User replaceable
CR2032 MFR	10	Yes
CR2032	25	Yes
CR2320	25	Yes
CR2325	25	Yes
CR2430	25	Yes
CR2450N	25	Yes
CR2477N	25	No
175-(a)	25	Yes
338A	25	Yes
1000-(a)	25	Yes

# Safety Guidelines

## UL safety tests



### Abnormal Charging Test

The cells were charged by being connected in opposition with a 12 V dc power supply. The current was controlled by connecting a resistor of the appropriate size in series with the cell. The test duration was based on the applied current and the capacity of the cells.

The cells were examined after these tests for any sign of change.

Five samples each of Models 1000-0, 1000-7 and CR2450N in the as-received condition were used in these tests.

**Results** None of the cells leaked. There were no fires or explosions as a result of tests at currents below 100 mA for the abnormal charging mode.

### Crush Tests

The cells were crushed between a flat surface and a cylindrical surface having a radius of curvature of 5/16 in. The force was applied by means of a hydraulic ram and the cells were crushed until the thickness at the point of maximum crushing was less than one-fourth of the original cell thickness. The temperatures on the exterior surface of the metal cell casing was monitored by means of an iron-constantan thermo-couple. The cells were examined after the

test for any signs of reaction due to the crushing. Five fresh Model CR916 cells were used in this test.

**Results** The casings opened and leaked as a result of this test. There was no temperature increase or any other adverse reaction as a result of this test.

### Explosion Test

A cast aluminum chamber, 6 in. in diameter and 12 in. high with a 3/4 in. vent opening, was used for the test. Iron flanges were attached to both ends of the chamber. A solid 0.020 in. steel plate and a second thicker reinforcing steel plate with a 4 in. diameter hole in the center were bolted together to the bottom flange. Each sample cell tested was placed in turn in the chamber and centered on the bottom plate. Steel plates weighing 30 lb. were placed on top of the chamber. A

1-1/2 in. diameter Meker burner was ignited and placed under the chamber. The chamber was heated until the test cell exploded. Five Model 1000-0, 1000-7 and CR2450N cells were used in these tests.

**Results** Models 1000-0 and 1000-7 exploded, however did not lift the lid. Model CR2450N did not explode, however a fire did occur inside the explosion chamber.

### Fire Exposure Tests

One sample was placed on a wire screen directly above a 2 in. diameter laboratory Meker burner fuelled by methane gas at a pressure of 0.5 psig and a flow rate of 3.0 ft<sup>3</sup>/h. The cells were heated until they exploded or until ultimate results were obtained. For protection and also to muffle the sound of any explosions, the cells were tested in a room separate from the observer. The results of

this test were used to determine if further testing would be needed to evaluate the fire exposure hazard of these cells. Five fresh cells were used in this test.

**Results** Models 1000-0, 1000-7 and CR2450N exploded. Based on these results, the Explosion Test was deemed necessary.

# Safety Guidelines

## UL safety tests

### Heating Tests

The power modules were heated in an oven. The temperature on the exterior surface of the module casing was measured by means of an iron-constantan thermocouple. The heating rate was controlled with a variable transformer and ranged

from 1°C/min. to 11°C / min. The heating was discontinued at 180°C (356°F). The modules were examined after the test for any signs of change.

The following modules were used in these tests:

Previous conditioning of modules	No. of 1000-2 cells	No. of 500-1 cells
Fresh modules	3	2
After oven exposure	2	3
After temperature cycling	3	2
Cells discharged at room temperature:		
Completely discharged	2	3
One-half discharged	3	2
Cells discharged at 71°C (160°F)		
Completely discharged	2	3
One-half discharged	3	2

**Results** There were no fires or explosions at temperatures below 165°C (329°F). There were no indications of increased reactivity as a result of exposure in the conditioning tests.

### Puncture and Leaking Test

Cells were punctured by cutting through the cell casing with a small grinding wheel until liquid or gas was released from the cell.

**Results** The cells were found to contain only a few drops of an organic liquid. The cells were not pressurized and no gas, liquid or solid particles were sprayed from the cells.

### Short Circuit Test

The cells were shorted by connecting the positive and negative terminals with a short length of copper wire. The temperature on the exterior surface of the metal cell casing was monitored during the test by means of an iron-constantan thermocouple.

Short circuit tests were conducted on cells at room temperature. After the tests, the cells were examined for any signs of change.

The following cells were used in these tests:

Model CR2450N	
Previous conditioning of cells	Number of cells at room temperature
Fresh cells	5

**Results** There were no signs of case bulging, leaking, or any other visible changes as a result of these tests. The maximum temperature measured on the exterior surface of the metal cell casings was 30°C (86°F) for the tests conducted at room temperature. The maximum temperatures were obtained in tests with fresh cells.

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## UL safety tests

### Temperature Cycling

Eighteen button cells of each CR2032 and CR2430 were left in following conditions. The cells were exposed to alternate temperatures of +20° and +100°C. The batteries were submitted to these temperatures in 60 cycles of two hours each and then discharged over a load of 8,25 k Ohms down to 2 volts in order to detect remaining capacity.

**Results** The cells showed no visible change as a result of the temperature cycling and relevant discharge results are shown in the diagrams of this page.

Ten each of the Modules 1000-2 and 500-1 were conditioned in this exposure. The modules were exposed to alternate temperatures of -54°C (-65°F) and 71°C (160°F) for a total of ten exposures at each temperatures. The modules were exposed at each temperature for periods of 16 h with 8 h periods at room temperature between each exposure. The temperatures of the oven and the cold box were monitored by means

of iron-constantan thermo-couples connected to a recording potentiometer.

**Results** None of the modules had a weight loss greater than 0.01 g and the maximum change in open circuit voltages was 0.1 V. There were no visible changes as a result of this exposure.

"Further tests have been executed, mainly with Models 500-1 and 1000-2: Discharge, Drop Test, Vibration Test, Oven Exposure and Humidity Test."

# Safety Guidelines

## Disposal of used batteries

### General Guidelines

The disposal of used batteries is governed by law in many countries world-wide. Therefore, please check your local regulations prior to battery disposal.

### Safety Precautions for disposal of used batteries.

### Safety precautions for the handling and storage of used lithium batteries.

Although environmentally friendly and free of harmful substances, lithium batteries are a powerful energy source and require some caution even if almost fully discharged. When disposing of large quantities of lithium coin cells it is necessary to take certain safety measures in order to avoid heat generation and the danger of fire due to mass short-circuiting:

- 1.** The number of lithium coin cells to be disposed of and placed in the same container during a day should be limited (if possible less than 100 pieces per day).
- 2.** The container for disposal should be made of metal (small steel drums are quite suitable), not

exceed a volume of 10 liters, be closed with a cover and have air holes in the upper area of the side walls.

**3.** For the storage of these containers, the following safety rules should be observed:

- Containers to be stored outdoors, protected from rain, at least 2 - 3 meters away from buildings.
- Distance between containers at least 1 meter.
- Storage area not accessible to unauthorized persons.

**4.** It is recommended to mix the batteries in the containers daily for one week in order to ensure complete discharge and prevent the battery waste from heating up at a later stage.

As indicated above, these safety measures are only necessary if relatively large quantities of lithium batteries must be disposed of at the same time. In the retail/consumer trade, where only single batteries are changed and used batteries of different kinds are mixed together, there is no risk of battery waste heating up dangerously.