

April 1, 2014

## **ELIY Power Demonstrates the Safety of a Large-Sized Lithium-ion Battery Cell in a Bullet Penetration Test**

ELIY Power Co., Ltd. (Head Office: Shinagawa-ku, Tokyo, Japan; President: Hiroichi Yoshida) today announced that it has conducted a bullet penetration test on a large-sized lithium-ion battery cell to demonstrate that there was no occurrence of smoke, ignition or explosion.

ELIY had conducted different tests on the safety of battery cells, such as a nail penetration test and a crushing test. The demonstration of its safety in the recent bullet penetration test opens the way for use in a broad array of applications.

### ◆ Test Details

(1) Purpose of Test: Checking the state of the battery cell after penetration with a rifle bullet

(2) Test Conditions

Firing position	A longitudinal surface of the battery cell
Outdoor temperature	Approx. 15 deg. C
Firing distance	Approx. 30 m
Bullet type	Equivalent to the 7.62 x 51 mm NATO
Bullet speed	Approx. 800 m/s
No. of test sessions	2

(3) Test Results

- No smoke or ignition was observed.
- Just after the bullet penetration, the voltage fell slightly and the temperature soared, but it stopped rising around 45 degrees Celsius.
- Apart from creation of a hollow, no change in exterior appearance was observed.
- After the penetration, the voltage hardly dropped and the light on the battery remained lit.

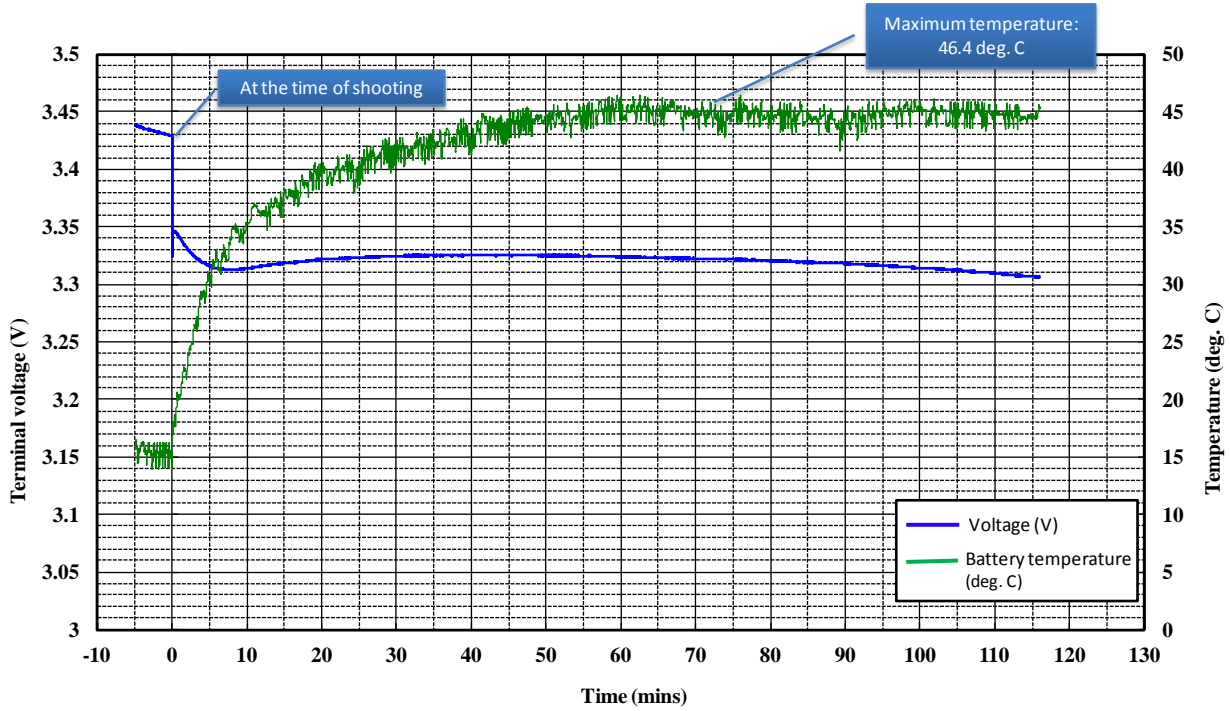
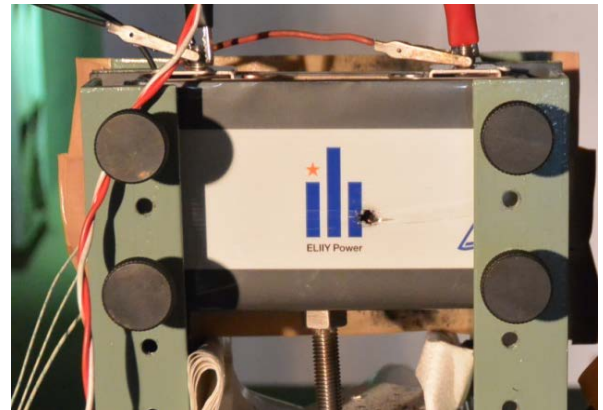
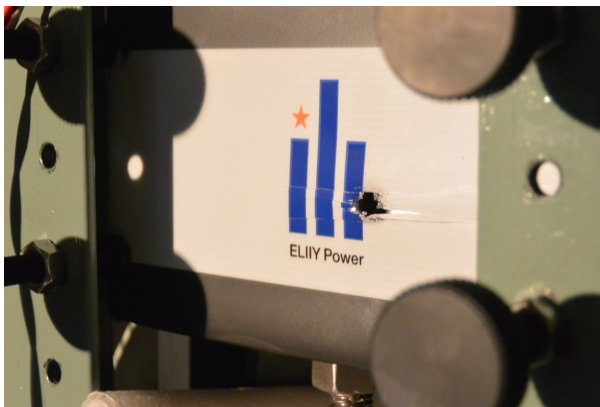


Figure: Results of the Bullet Penetration Test with a Battery Cell (with a Light Bulb on)

(4) Test Results in Photos

Photo 1: Results of the first test session

[Bullet Entry Side]



[Bullet Exit Side]

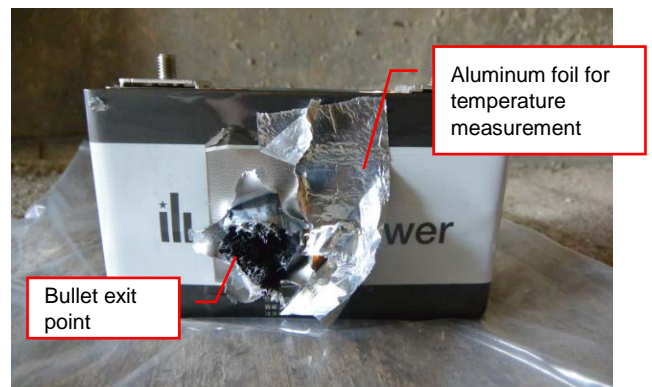
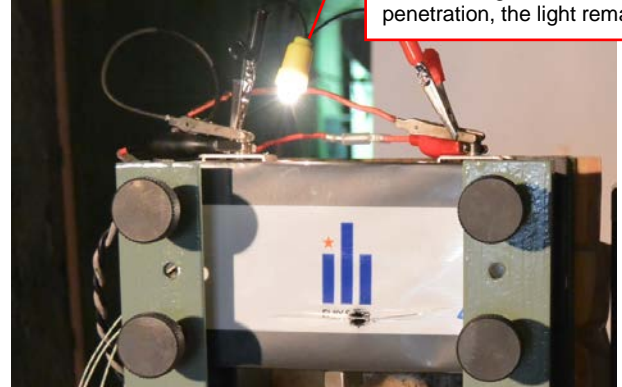
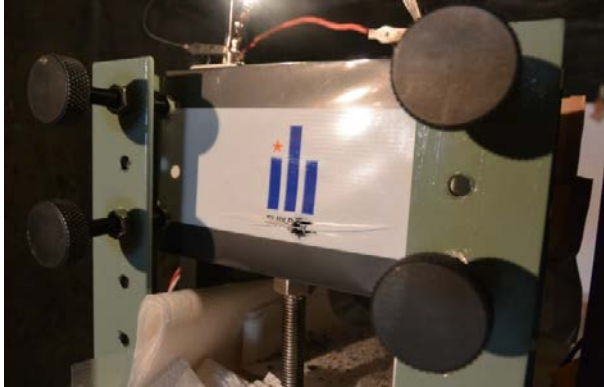


Photo 2: Results of the second test session  
[Bullet Entry Side]



[Bullet Exit Side]



◆ Reference 1: Battery Cell Specifications

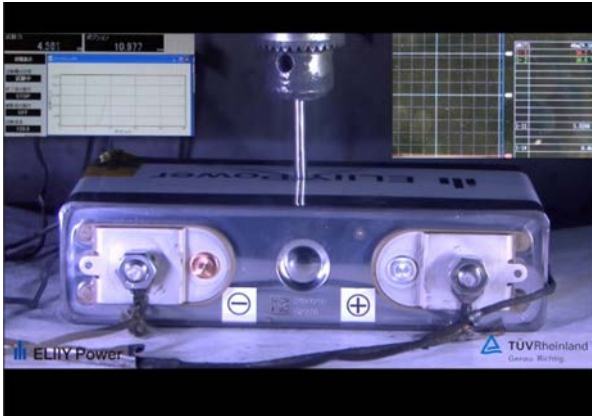


Rated capacity:	50 Ah
Rated voltage:	3.2 V
Weight:	1.5 kg
Dimensions:	170.5 mm (W) × 43.5 mm (D) × 111.9 mm (H)
Energy density:	106 Wh/kg
Operating temperature:	-20 deg. C to 60 deg. C (Operation guaranteed from 0 deg. C to 45 deg. C)
Cathode material:	Lithium iron phosphate
Anode material:	Carbon

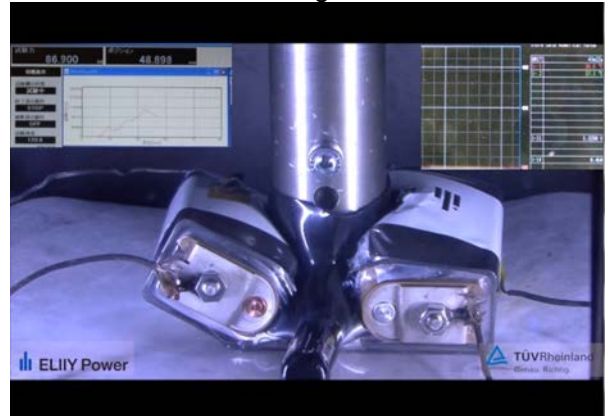
◆ Reference 2: Battery Cell Features

- A high level of safety with no smoke or ignition was observed in the nail penetration test (internal short circuit) and the crushing test
- The world's first large-sized lithium-ion battery cell to acquire the TÜV-S certification mark\*<sup>1</sup>
- Such a long life that at least 80% of the capacity retained after 12,000 cycles\*<sup>2</sup> of recharge and discharge in a ten-year period

Nail Penetration Test



Crushing Test



\*1 Certification with the safety standards (*Manual for Testing Lithium-Ion Cells under Severe Conditions v. 2:2011*) issued by TÜV Rheinland Japan Ltd., a global third-party testing and certifying body

\*2 Value estimated from the data obtained from the acceleration test conducted by ELIY Power at a room temperature of 23 degrees Celsius and approximately three cycles of full recharge and discharge per day at the depth of discharge (DOD) of 100%

Since its establishment in 2006, ELIY Power has been putting safety first in technology and product development. It will continue its endeavors to develop and diffuse large-sized lithium-ion batteries and electricity storage systems in accordance with the philosophy of encouraging the spread of systems that store and consume energy in a bid to help solve global energy and environmental issues.

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