Standardization Update including IEC Standards for Li-ion batteries

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International Battery Standard Committee
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1. Introduction

Mechanism of Serious Accident
Almost of the cases of cell internal short-circuit is not dangerous. The probability of catching fire is PPB (Point Per Billion) level.

The trigger of the accident is the internal short-circuit between the positive electrode and negative electrode. If it spreads out instantly (the probability is PPB level), the cell catches fire.

120～150°C  180～200°C  >500°C

Abnormal heat generation  Rise in heat

Anode(LiC6) — Electrolyte reaction  Cathode(LiCoO2) decomposition  Thermal Runaway Electrolyte combustion
1-2. The Cell Operating Region

Exceeding the Cell Operating Region (Safe Area of Voltage, Current, Temperature Range) by mis-use or mis-design of the equipment increases the Risks.

The Cell Operating Region was firstly defined in IEC 62133 Ed.2.
1-3. Cell Internal Short-Circuit Test

**Forced Internal Short-Circuit (FISC) Test**
To fulfill the requirement of the Forced Internal Short-circuit Test in JIS C 8714 has been mandatory by a law in Japan since Nov. 2008. The number of the fire incidents has been decreased significantly since then in Japan. FISC Test was defined in IEC62133 Ed.2 as well.

![Diagram of cell internal short-circuit test](image)

- **Negative electrode (Anode)**
- **Separator**
- **Positive electrode (Cathode)**
- **Cu foil**
- **Al foil**
- **Ni**

**Position A**
- **Press**

**Position B**
- **Press**

The critical area;
Bare Aluminum foil facing the Negative active material.
Short-circuit in the area leads to fire easily.
2. Portable applications

**IEC62133**
The current IS (IEC62133 Ed.2 published in Dec. 2012) includes Cell Operating Region and FISC Test.

Revised version;
CDV(Committee Draft for Voting) will be circulated in May or June 2015.
IEC62133 will be divided to 2 standards.
   - IEC62133-1(Ni-Cd, Ni-MH)
   - IEC62133-2(Li ion)
The contents are almost same as IEC62133 Ed.2.
3. Industrial applications

Stationary applications:
Telecom, uninterruptible power supply (UPS), utility switching, emergency power etc.

Motive applications:
Folk-lift truck, golf cart, AGV, railway, and marine excluding road vehicles.

IEC62620 (Performance)
IS was published on Nov. 25, 2014.

IEC62619 (Safety)
CDV will be circulated in May or June 2015.
New test (Propagation test) is firstly defined in it. Propagation test or FISC test is required.
3. Industrial applications

**Propagation test** is firstly defined in IEC62619.

a) Requirement
This test evaluates the ability of a battery system to withstand a single cell thermal runaway event so that a thermal runaway event does not result in the battery system fire.

b) Test
The battery system is fully charged and then left until the cells stabilize at 25 °C ± 5 °C. One cell in the battery system is heated until the cell enters thermal runaway, for example, using resistive heating or through thermal conductive heat transfer using an external heat source. The method used to create a thermal runaway in one cell is to be described and documented in the test report. After thermal runaway in the cell is initiated, the heater is turned off and battery system is observed for 1 hour.

c) Acceptance criteria
No external fire from the battery system or no battery case rupture.

Note 1 to entry: Fire caused by the first cell is acceptable because the first thermal runaway is intentionally made for the test purpose as a trigger.
4. EESS (Electric Energy Storage System)
   Li ion Cells and Batteries for EESS are generally covered by IEC62620 and IEC62619.
   The related standards are under development as follows.

   **IEC61427-2** by TC21 JWG82
   Cells and Batteries for On-grid applications
   FDIS (Final Draft) ; April or May 2015

   **IEC62897**
   Li Batteries Safety Requirements for Stationary EES
   2nd NP (New Proposal) is under development

   **EESS System Standard** (not battery standard)
   Under development by IEC TC120
   IEC62937(Safety)    IEC62936(Environment) etc.
5. Automobile applications

**IEC62660-3 (Safety with Criteria)**
Secondary lithium-ion cells for the propulsion of electric road vehicles - Part 3 Safety Requirements
CDV : around April, 2015
It includes Cell Operating Region and FISC Test.

**TR (Technical Report, Under development)**: around April, 2015
Candidate alternative test methods for the internal short circuit test of IEC 62660-3
Blunt rod test will be proposed, and the reasonable and reproducible results as data are necessary.
6. Conclusion

New IEC Battery Standards for Industrial applications (EESS (Electric Energy Storage System) etc.) and Automobile applications are under development and increasing.

The important requirements *(Cell Operating Region)* and FISC test developed in IEC62133 are included in the most of them.

Propagation test firstly developed in IEC62619 is considered very useful for Industrial and Automobile applications for the safety test.