IEC62133 (2nd edition) Safety Test Standard of Li-Ion Cell and Battery

Insulation and wiring

The insulation resistance between the positive terminal and externally exposed metal surfaces of the battery excluding electrical contact surfaces shall be not less than 5 MΩ at 500V DC.

Charging methods

Method 1:

- Same as 1st edition method
- Applicable to all tests except external short circuit, thermal abuse, crush and forced internal short circuit tests

Method 2:

- Applicable to cells and batteries subjected to the external short circuit, thermal abuse, crush and forced internal short circuit tests.
- Condition cell/battery at either the upper or lower limit charge temperature of the cell operating region for 1-4 h
- CV Charge cell/battery at the upper limit charge voltage of the cell operating region until the charging current is reduced to 0.05 I_t A

Upper limit charging voltage	Max. charging current	Charging temperature upper limit	Charging temperature lower limit
4.25 V/cell	Specified by cell mfg	45℃	10℃

8.2.1 Continuous charging at constant voltage (5 cells)

- Continuous CV charge per mfg specifications for 7 days

8.2.2 Moulded case stress at high ambient temperature (Moulded case battery)

Each fully charged battery is crushed between two flat surfaces. The force for the crushing is applied by a hydraulic ram exerting a force of 13 kN ± 1 kN. The crushing is performed in a manner that will cause the most adverse result. Once the maximum force has been applied, or an abrupt voltage drop of one-third of the original voltage has been obtained, the force is released. A cylindrical or prismatic cell is crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus. To test both wide and narrow sides of prismatic cells, a second set of cells is tested, rotated 90° around their longitude in a axes compared to the first set.

8.3.1 External short circuit (5 cells per temperature)

- Using charge method 2 to fully charge cell. Each cell is then short-circuited by connecting the positive and negative terminals with a total external resistance of 80 mΩ ± 20 mΩ, The cells remain on test for 24 h or until the case temperature declines by 20 % of the maximum temperature rise, whichever is the sooner.
- Test at 20 °C ± 5 °C only

8.3.2 External short circuit (5 battery per temperature)

- Using charge method 2 to fully charge battery. Each battery is then short-circuited by connecting the positive and negative terminals with a total external resistance of 80 mΩ ± 20 mΩ, The battery remain on test for 24 h or until the case temperature declines by 20 % of the maximum temperature rise, whichever is the sooner.
- Test at 55 °C ± 5 °C only
- In case of rapid decline in short circuit current, the battery pack remains on test an additional hour after the current reaches a low end steady state condition (*e.g. battery with series connections voltage is below 0.8 V and decreasing < 0.1 V/ 30-minute period*)

8.3.3 Free fall (3 cells or 3 batteries)

- Each fully charged cell or battery is dropped three times from a height of 1,0 m on to a concrete floor .The cells or batteries are dropped so as to obtain impacts in random orientations.
- Cells/Batteries are examined 1 hour after dropping

8.3.4 Thermal abuse (5 cells)

Each fully charged cell by charging method 2 , stabilized at room temperature, is placed in a gravity or circulating air-convection oven. The oven temperature is raised at a rate of 5 °C/min ± 2°C/min to a temperature of 130°C ± 2 °C. The cell remains at this temperature for 10 min before the test is discontinued.

Large cells (i.e. gross mass > 500 g) held at 130 C for 30 min.

8.3.5 Crush (5 cells)

Each fully charged cell by charging method 2, is crushed between two flat surfaces. The force for the crushing is applied by a hydraulic ram exerting a force of 13 kN ± 1 kN. The crushing is performed in a manner that will cause the most adverse result. Once the maximum force has been applied, or an abrupt voltage drop of one-third of the original voltage has been obtained, the force is released. A cylindrical or prismatic cell is crushed with its longitudinal axis parallel to the flat surfaces of the crushing apparatus. To test both wide and narrow sides of prismatic cells, a second set of cells is tested, rotated 90° around their longitude in a axes compared to the first set.

Force can also be stopped when 10 % of deformation of initial dimension of cell has occurred (*or when* 13 kN ± 1 kN *force is reached or abrupt drop of 1/3 original OCV, whichever is reached first*)

- Crush only wide side of prismatic cells

8.3.6 Over-charging of battery

- CC charge at 2.0 I_t A, using a supply voltage that does not exceed the max voltage supplied by the recommended charger or 5.0 V/cell if charger max voltage unknown
- Charging supply is sufficient to maintain 2.0 I_t A throughout the duration of test or until supply voltage is reached (switch to CV charge).
- TC placed on battery surface/pack casing. Charging continued until the temperature of the outer casing reaches steady state conditions *(less than 10 °C change in 30 minute period*) or returns to ambient

8.3.7 Forced discharge (5 cells)

A discharged cell is subjected to a reverse charge at 1 It A for 90 min.

8.3.8 Transport tests*

Tests not needed if UN transport documents are provided