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**Energy conversion efficiency requirements and measurement
methods for lithium ion cells and batteries**

锂离子电池和电池组能源转换效率要求和测量方法

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1 Scope

This Document specifies the energy conversion efficiency requirements for lithium-ion cells and batteries; and describes the calculation method and measurement method.

This Document applies to lithium-ion cells and batteries.

2 Normative References

There are no normative references in this Document.

3 Terms and Definitions

For the purposes of this Document, the following terms and definitions apply.

3.1 Lithium ion cell

A device that relies on the movement of lithium ions between the positive and negative electrodes to achieve the mutual conversion between chemical energy and electrical energy, and is designed to be rechargeable.

NOTE. The device includes electrodes, separators, electrolytes, containers and terminals, etc.

3.2 Lithium ion battery

An assembly that consists of any number of lithium-ion batteries and ready for use.

NOTE. The assembly includes protection circuits and may also contain packaging materials, connectors, protection devices, etc.

3.3 Coulombic efficiency; η_{c}

The percentage of the amount of charge output when the battery is discharged to the amount of charge input when it was previously charged.

NOTE 1. Unless otherwise specified, the coulombic efficiency in this document refers specifically to the efficiency at the same rate.

3.10 Cell (battery) energy; E

The electrical energy input/output of a cell (battery) under specified conditions.

[SOURCE. GB/T 2900.41-2008, 482-03-21, modified]

3.11 Charge energy; E_{c}

The electrical energy input by the cell under specified conditions.

3.12 Discharge energy; E_{d}

The electrical energy output by the cell under specified conditions.

NOTE. The international unit of energy is Joule ($1 \text{ J} = 1 \text{ Ws}$), but actually cell energy is usually expressed in watt-hours (Wh) ($1 \text{ Wh} = 3,600 \text{ J}$).

[SOURCE. GB/T 2900.41-2008, 482-03-21]

3.13 Reference test current; I_{t}

The test current has the same value as the rated capacity (C).

NOTE. The unit is ampere (A) or milliampere (mA).

3.14 Limited charging voltage; Ucl

The rated maximum charging voltage of a cell or battery that is specified by the manufacturer.

3.15 End of discharge voltage; Ude

The voltage of a cell or battery at the end of discharge as recommended by the manufacturer.

3.16 Recommendation charging current; Icr

Constant charging current recommended by the manufacturer.

3.17 Recommendation discharging current; Idr

Continuous discharging current recommended by the manufacturer.

4.1 Test environmental conditions

Unless otherwise specified, the test is generally carried out under the following conditions.

- a) Temperature. $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$;
- b) Relative humidity. no more than 90%;
- c) Air pressure. 86 kPa~106 kPa.

4.2 Parameter measurement tolerance

Relative to the specified value or actual value, the accuracy of all control values or measured values shall be within the following tolerance range.

- a) Voltage. $\pm 0.1\%$;
- b) Current. $\pm 1\%$ of the used range;
- c) Temperature. $\pm 2\text{ }^{\circ}\text{C}$;
- d) Time. $\pm 0.1\%$;
- e) Capacity. $\pm 1\%$;
- f) Energy. $\pm 1\%$.

4.3.1 Charging procedure for pretreatment

Before charging, the cell or battery should be discharged at 0.2It to the end of discharge voltage at an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$. The cell or battery may be charged in the following test by the following method.

At an ambient temperature of $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$, charge at a constant current of $0.2I_t$. When the cell terminal voltage reaches the limited charging voltage; change to constant voltage for charging until the charging current is less than or equal to $0.02I_t$, stop charging, and the maximum charging time shall not exceed 8 h.

4.3.2 Discharge procedure for pretreatment

The cell is discharged at a constant current to the end of discharge voltage according to the recommendation discharging current specified by the manufacturer.

4.3.3 Time interval between charging and discharging

After the cell is charged and discharged for two cycles according to the provisions of 4.3.1 and 4.3.2, it is tested according to Clauses 5 and 6. The time interval between the charging and discharging procedures is the current rate used in the previous charging process multiplied by 60 min.