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Lithium ion cells and batteries used in portable electronic equipment - Safety technical specification

便携式电子产品用锂离子电池和电池组 安全技术规范

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Lithium ion cells and batteries used in portable electronic equipment - Safety technical specification

1 Scope

This document specifies the safety requirements and test methods for lithium ion cells and batteries used in portable electronic equipment.

This document applies to lithium ion cells and batteries used in portable electronic equipment (hereinafter referred to as cells and batteries). Examples of portable electronic equipment within the scope of this document are as follows:

a) portable office products: laptops, tablets, etc.;

b) mobile communication products: mobile phones, cordless phones, walkie-talkies, etc.;

c) portable audio/video products: portable TV sets, portable audio/video players, cameras, video cameras, recording pens, Bluetooth headsets, portable speakers, etc.;

d) other portable products: electronic navigators, digital photo frames, game consoles, e-books, power banks, portable energy storage power supplies, portable projectors, wearable devices, etc.

This document may apply, as a reference, to lithium ion cells and batteries for similar purposes to the examples above.

There may be additional requirements for lithium ion cells or batteries for portable electronic equipment used in specific occasions such as vehicles, ships, and aircraft, as well as in special fields such as medical treatment, mining, and submarine operations.

This document does not apply to lithium ion cells and batteries for electronic cigarettes.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the version corresponding to that date is applicable to this document; for undated references, the latest version (including all amendments) is applicable to this document.

GB/T 2423.5, Environmental testing - Part 2: Test methods - Test Ea and guidance: Shock

GB/T 2423.10, Environmental testing - Part 2: Test methods - Test Fc: Vibration (sinusoidal)

GB/T 2423.21, Environmental testing - Part 2: Test methods - Test M: Low air pressure

GB/T 2423.22, Environmental testing - Part 2: Tests methods - Test N: Change of temperature

GB 4943.1-2022, Audio/video, information and communication technology equipment - Part 1: Safety requirements

GB/T 5169.5-2020, Fire hazard testing for electric and electronic products - Part 5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance

GB/T 5330-2003, Industrial woven metal wire cloth (square opening series)

GB/T 6005-2008, Test sieves - Metal wire cloth perforated metal plate and electroformed sheet - Nominal sizes of openings

GB/T 17626.2, Electromagnetic compatibility - Testing and measurement techniques - Electrostatic discharge immunity test

3 Terms and definitions

The following terms and definitions are applicable to this document.

3.1

Lithium ion cell

A device – designed to be rechargeable – that realizes the mutual conversion of chemical energy and electrical energy by relying on the movement of lithium ions between the positive and negative electrodes.

Note: The device includes electrodes, diaphragms, electrolytes, containers and terminals, etc.

3.2

Lithium ion battery

A ready-to-use assembly consisting of any number of lithium ion batteries including a protective circuit.

Note 1: The protective circuit may either be independent, or in the charger or electronic product (including its accessories). For the test of the protective circuit in the charger or electronic product (including its accessories), see Chapter 11.

Note 2: The lithium ion battery may also contain components or materials such as packaging materials, connectors, and protective devices.

3.3

Portable electronic equipment

A mobile electronic product – not exceeding 18 kg – that is intended to be frequently carried by users.

3.4

Hand-held electronic equipment

Portable electronic equipment that is intended to be held in the hand during normal use.

3.5

User replaceable battery

A lithium ion battery – allowing direct user replacement – that is used in portable electronic equipment.

3.6

Non-user replaceable cell/battery

A lithium ion cell or lithium ion battery – not allowing direct user replacement – that is built into portable electronic equipment.

3.7

Nominal voltage

An appropriate approximate value that is used to identify the cell or battery voltage.

3.8

Rated capacity

C

The cell or battery capacity that is indicated by the manufacturer.

Note: in ampere hours (Ah) or milliampere hours (mAh).

Note: Flame is produced by combustion, which is a chemical reaction that emits light and generates heat. A spark cannot be called a flame.

[Source: GB/T 28164-2011, 1.3.13, modified]

3.31

Fire enclosure

A part that is used to minimize the spread of combustion or flame.

3.32

Type test

A test that is carried out on representative samples, which is to determine whether its design and manufacture can meet the requirements of this document.

[Source: GB 4943.1-2022, 3.3.6.15, modified]

4 Test conditions

4.1 Applicability of the test

The tests, which are specified in this document, shall be carried out only when safety is involved.

When the standard content clearly stipulates that a certain type of cell or battery is not applicable to the product test due to the product design, structure, and function constraints, the test may not be performed. Where the cell or battery cannot be tested due to constraints of product design, structure or function, but such a test needs to be carried out, a relevant test can be carried out instead, by testing the electronic products of the cell or battery, the charger attached to the electronic product, or the components that form part of the electronic product, together with the cell or battery.

Note: The portable electronic equipment and its attached charger or components that form part of it come from the manufacturer of the cell or battery or the manufacturer of the electronic product, who shall provide operating instructions.

Unless otherwise specified, the samples after the test are not required to be used normally.

4.2 Environmental conditions for the test

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

a) temperature: 20 °C ± 5 °C;

It is recommended to discharge the cell or battery at a constant current at the recommendation discharging current (I_{cr}) to the end of discharge voltage (U_{de}).

4.6 Simulated faults or abnormal operating conditions

Simulated faults or abnormal operating conditions, if required, shall be applied sequentially, with one fault simulated at a time. Failures directly caused by simulated faults or abnormal operating conditions are considered part of the simulated faults or abnormal operating conditions.

When a single fault is set, this single fault shall include failure of any component.

Circuit boards, circuit diagrams and component specifications shall be inspected to determine reasonably foreseeable failure conditions, such as:

a) short circuit and open circuit between any two pins of a semiconductor device;

b) short circuit and open circuit of the capacitor;

c) short circuit and open circuit of the current limiting device;

d) short circuit and open circuit of the voltage limiting device;

e) an internal fault causing excessive power consumption in the integrated circuit.

4.7 Type test

4.7.1 Requirements for samples

Unless otherwise specified, the tested samples shall be representative samples of the products which are going to be accepted by the customer, including a small batch of trial production samples or products that are ready to be delivered to the customer.

Where the test requires the introduction of wire testing or connection, the total resistance generated by the introduction of wire testing or connection shall be less than 20 mΩ.

4.7.2 Number of samples

Unless otherwise specified, 3 samples shall be prepared for each test item.

4.7.3 Sample capacity test

The actual capacity of the cell or battery sample shall be greater than or equal to its rated capacity, otherwise, it cannot be used as a typical sample for the type test.

Note: Unless otherwise specified, the above requirements are for type tests only.

First, fully charge the sample according to the charging procedure specified in 4.5.1; then, leave for 10 minutes; then, discharge according to the discharging procedure specified in 4.5.2. The capacity provided during discharge is the actual capacity of the sample.

Where there is disagreement with the capacity test result, the test can be re-performed at the ambient temperature of 23 °C ± 2 °C, which is used as the arbitration condition.

4.7.4 Sample pretreatment

Before carrying out the test items specified in 4.7.5, the sample shall be pretreated as follows.

a) Charge-discharge cycle

Carry out two complete charge-discharge cycles for the cell or battery in accordance with the charge-discharge procedure specified in 4.5, with a 10 min break between the charge and discharge procedure.

Note 1: The capacity test can be carried out at the same time during the pretreatment of a) charge-discharge cycle, and the smaller value of the capacity after two complete charge-discharge cycles is taken as the sample capacity.

b) Electrostatic discharge

For the battery with its own protective circuit, after the pretreatment of a) charge-discharge cycle is completed, fully charge according to the charging procedure specified in 4.5.1 and, according to the provisions of GB/T 17626.2, carry out 4 kV contact discharge test (±4 kV each 10 times) and 8 kV air discharge test (±8 kV each 10 times) on each output terminal of the battery.

Note 2: The samples in Chapter 8 are not subjected to electrostatic discharge pretreatment.

In the pretreatment process, such phenomena as fire, explosion, liquid leakage, etc. are also considered not to meet the requirements of this document.

4.7.5 Test items

Unless otherwise stated, the tests specified in this document are type tests.

The type test items of cell are shown in Table 1, and the Arabic numerals in the “sample” column are the serial numbers of test samples.

Example 4: Do not use after immersion in water.

For user replaceable batteries that can be put into the swallowing gauge, warning instructions in Chinese shall also be given on their min. package.

Example 5: Small cells that may be swallowed by children must be kept out of reach of children.

Example 6: Do not swallow cells, swallowing may cause burns.

Example 7: If swallowed, seek medical attention promptly.

Swallowing gauge test tooling shall be in accordance with C.1 of Appendix C.

Note: When the battery is sold separately, the min. package refers to the min. package of the battery; when the battery is sold together with an electronic product, the min. package can also be the min. package of the electronic product.

5.3.3 Durability

The labeling and warning instructions on the battery body shall be clear and legible.

Any labeling and warning instructions on the battery body, which are required by this document, shall be durable and eye-catching. When considering its durability, the effect of normal use shall be taken into consideration.

Check and wipe the labeling and warning instructions, to verify whether it is qualified. When wiping the labeling and warning instructions, use a cotton cloth dipped in water to wipe for 15 seconds, then use a cotton cloth dipped in 75% (volume fraction) medical alcohol to wipe for 15 seconds. After the test, the labeling and warning instructions shall still be clear, the nameplate shall not be easily removed, and there shall be no curling.

Note: This article applies to user replaceable battery only.

5.4 Safety-critical components

5.4.1 Basic requirements

Where safety is involved, cells, batteries, and components in protective circuits, such as positive temperature coefficient thermistors (PTCs), thermal fuses, etc., shall comply with the requirements of this document, or shall comply with the national standards, industry standards or safety-related requirements in other specifications for the relevant components. Refer to Appendix D for reference standards.

Note: Only when a certain component obviously belongs to the national standard, industry standard or other scope of application of a certain component, can the standard be considered relevant.

5.4.2 Evaluation and testing of components

The evaluation and testing of components shall be carried out in accordance with the following provisions.

a) When a component has been proven to comply with the national standard, industry standard or other coordinated specifications of a relevant component, it shall be checked whether the component is correctly applied and used according to its rated value. The component – as an integral part of the cell, battery or protective circuit – shall also be subjected to the relevant tests specified in this document, but not to that part of the test specified in the relevant national, industrial standards or other specifications for the component.

b) When a component has not been verified as described above whether it complies with the relevant standards, it shall be checked whether the component is correctly applied and used according to the specified rated value. The component – as an integral part of the cell, battery or protective circuit – shall also be subjected to the relevant tests specified in this document, and also to the relevant tests specified in the standard for the component according to the actual conditions in the cell, battery or protective circuit.

Note: In order to check whether a component complies with the standard of a certain component, the relevant test is usually carried out on the component alone.

c) If there is no corresponding national standard, industry standard or other specifications for a certain component, the component shall be tested according to the conditions actually existing in the cell, battery or protective circuit. The number of samples required for the test is usually the same as that required for the equivalent standard.

6 Electrical safety test of cell

6.1 High temperature external short circuit

After fully charging the cell in accordance with the test method specified in 4.5.1, place it in an environment of 57 °C ± 4 °C; after the cell surface temperature reaches 57 °C ± 4 °C, place it for another 30 minutes. Then, use wires to connect the positive and negative polarities of the cell at this ambient temperature; ensure that all external resistances are 80 mΩ ± 20 mΩ. During the test, monitor the temperature change of the cell. When any of the following two situations occurs, terminate the test:

a) The temperature drop of the cell reaches 20% of the maximum temperature;

b) The short-circuit time reaches 24 hours.

In case of dispute, choose the stricter one between a) and b).

The cell shall not have fire or explosion.

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