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Secondary lithium cells and batteries used in electrical energy storage systems—Safety requirements

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Foreword

This document is drafted in accordance with the provisions of GB/T 1.1-2020 Directives for Standardization - Part 1: Rules for the Structure and Drafting of Standardizing Documents.

Please note that certain contents of this document may involve patents. The issuing authority of this document shall not be liable for identifying such patents.

This document is proposed and administered by the Ministry of Industry and Information Technology of the People's Republic of China.

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Introduction

This document only specifies the fundamental safety requirements for lithium secondary cells and battery packs used in electrical energy storage systems to protect personal and property safety, and does not cover performance and functional characteristics.

With the further advancement of technologies and manufacturing processes, it will be imperative to revise this document accordingly.

Within the scope of this document, the hazards caused by lithium secondary cells and battery packs refer to the following:

Leakage: which may directly pose chemical corrosion hazards to the human body, or cause insulation failure inside battery-powered electronic devices, thereby indirectly leading to electric shock, fire, and other hazards;

Fire: which may directly cause burns to the human body, or pose fire hazards to battery-powered electronic devices;

Explosion: which may directly endanger the human body or damage equipment;

Overheating: which may directly cause burns to the human body, or lead to the reduction of insulation class and the degradation of safety component performance, or ignite flammable liquids;

Electric shock: which refers to injuries caused by electric current passing through the human body, such as burns, muscle spasms, ventricular fibrillation, etc.

Battery packs with output voltage exceeding the safe voltage limit (DC 60 V) may directly cause electric shock hazards. Similarly, battery packs that can generate voltage exceeding the safe voltage limit (DC 60 V or AC peak value of 42.4 V) through inversion may also lead to electric shock hazards.

The priority sequence for determining the design scheme of lithium secondary cells or battery packs is as follows:

Firstly, if feasible, prioritize the selection of materials with high safety performance;

Secondly, if the above principle is not applicable, protective devices shall be designed to reduce or eliminate the possibility of hazards, such as adding protective components;

Finally, marking and instructions shall be provided for residual hazards that cannot be completely avoided.

The above principles do not replace the detailed requirements of this document, but only serve to help designers understand the rationale behind these requirements.

The safety of lithium secondary cells and battery packs is related to their material selection, design, manufacturing processes, transportation and service conditions. Service conditions include normal operating conditions, reasonably foreseeable misuse, abuse and fault conditions, as well as environmental conditions affecting their safety such as temperature, altitude and other factors.

The safety requirements for lithium secondary cells and battery packs cover the hazards to personnel caused by all the above factors. Personnel refer to maintenance personnel and end users.

Maintenance personnel refer to the staff responsible for repairing electronic devices and their batteries. They can utilize professional skills to avoid potential injuries when obvious hazards are present. However, maintenance personnel shall be protected against unexpected hazards, for example, using markings or warning instructions to remind them of residual hazards.

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End users refer to all personnel except maintenance personnel. Safety protection requirements are formulated on the assumption that end users have not received training on hazard identification, but will not intentionally create hazardous conditions.

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Secondary lithium cells and batteries used in electrical energy storage systems—Safety requirements

1 Scope

This document specifies the safety requirements for lithium secondary cells and battery packs used in electrical energy storage systems, and describes the corresponding test methods.

This document applies to lithium secondary cells and battery packs for electrical energy storage systems (hereinafter referred to as cells and battery packs). Applications of electrical energy storage systems include but are not limited to the following:

a) Telecommunications;

b) Central emergency lighting and alarm systems;

c) Fixed engine starting;

d) Photovoltaic systems;

e) Large-capacity energy storage: grid-connected/off-grid.

The electrical energy storage systems listed above do not cover all applicable equipment; therefore, equipment not included may also fall within the scope of this document. The battery packs within the scope of this document usually have a rated energy of more than 100 kWh. For battery packs with a rated energy of 100 kWh or less, refer to GB 40165 for safety requirements.

2 Normative References

The contents of the following documents are incorporated as indispensable provisions of this document through normative reference in the text. For dated referenced documents, only the edition corresponding to the stated date applies to this document; for undated referenced documents, the latest edition (including all amendments) applies 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 for electric and electronic products—Part 2: Test methods—Test M: Low air pressure

GB/T 2423.22 Environmental testing—Part 2: Test methods—Test N: Temperature change

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

GB/T 5169.16 Fire hazard testing for electrical and electronic products—Part 16: Test flame—50 W horizontal and vertical flame test methods

GB/T 5169.21 Fire hazard testing for electrical and electronic products—Part 21: Abnormal heat—Ball pressure test method

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

GB 31241-2022 Safety technical specification for lithium-ion cells and battery packs for portable electronic products

3 Terms and Definitions

The following terms and definitions apply to this document.

3.1 secondary lithium cell

A secondary cell that generates electrochemical energy through lithium-ion intercalation/deintercalation reactions or lithium redox reactions between the positive electrode and negative electrode.

Note： A cell generally contains an electrolyte composed of a mixture of lithium salts and organic solvents in liquid, sol-gel, or solid form, as well as a metal or film packaging. It cannot be used in equipment because it has not been fitted with an outer casing, external connection terminals, and electronic control devices.

[Source: IEC 63056:2020, 3.7]

3.2 large secondary lithium cell

A secondary lithium cell with a total mass exceeding 500 g.

Note： This term is abbreviated as large cell in this document.

3.3 cell block

A group of cells connected in parallel, which may or may not be equipped with protective devices [such as fuses or positive temperature coefficient (PTC) thermistors] and monitoring circuits.

Note： It cannot be used in equipment because it has not been fitted with an outer casing, external connection terminals, and electronic control devices.

[Source: IEC 63056:2020, 3.8]

3.4 module

A group of cells connected in series, parallel, or series-parallel connection, which may or may not be equipped with protective devices [such as fuses or positive temperature coefficient (PTC) thermistors] and monitoring circuits.

[Source: IEC 63056:2020, 3.9, with modifications]

3.5 battery pack

An electrical energy storage device consisting of one or more cells or modules connected electrically.

Note 1： It includes a monitoring circuit that provides information (e.g., cell voltage) for the battery system.

Note 2： It may include a protective cover provided by terminals or other interconnection devices.

[Source: IEC 63056:2020, 3.10, with modifications]

3.6 battery system

A system consisting of one or more cells, modules, or battery packs.

Note 1： It is equipped with a battery management system (BMS), which will activate in the event of overcharge, overcurrent, overdischarge, overheating, etc.

Note 2： Overdischarge cutoff is not mandatory if agreed upon by the battery manufacturer and user.

Note 3： It may include cooling or heating devices, and some even incorporate charge-discharge modules and inverter modules.

Note 4： Multiple battery systems can be combined to form a larger battery system.

[Source: IEC 63056:2020, 3.11, with modifications]

3.7 large secondary lithium battery

A secondary lithium battery with a total mass exceeding 12 kg.

Note： This term is abbreviated as large battery in this document.

3.8 battery management system (BMS)

An assembly connected to a battery system, which has protective functions to prevent overcharge, overcurrent, overheating, overcooling, and overdischarge (when applicable) of the battery system. It is used to monitor and/or manage the status of the battery system, calculate secondary data, report data, and/or control the environment to affect the safety, performance, and/or service life of the battery system.

Note 1： Overdischarge cutoff is not mandatory if agreed upon by the battery manufacturer and user.

Note 2： The functions of the BMS may be integrated into the battery pack or the equipment using the battery system.

Note 3： The BMS may be split, with part integrated into the battery pack and part located in the equipment using the battery system.

Note 4： The BMS is sometimes also referred to as a battery management unit (BMU).

Note 5： Examples of BMS locations and the composition of a battery system are shown in Figure 1.

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