ICS 29.220.99
CCS K 82

NATIONAL STANDARD OF THE PEOPLE'S REPUBLIC OF CHINA

GB/T 42728-2023

Guidelines for safety design of lithium ion batteries

锂离子电池组安全设计指南

Issued on: August 6, 2023 **Implemented on: March 1, 2024**

Issued by: State Administration for Market Regulation;
Standardization Administration of the PRC

Table of Contents

1 Scope

GB/T 42728-2023 gives guidance on the safety design of lithium-ion battery packs. Where the companion guidance on safe use addresses how a pack is treated, this one addresses how it is built, and the distinction matters because most pack fires are decided at design: cells chosen badly or matched badly, a protection circuit that does not cover every fault, spacing that lets one cell's failure propagate to its neighbours, and materials that feed the fire once it starts. The standard sets the general design principles, the labelling and warning instructions and their durability, then the cells - their selection, capacity, consistency, quantity, assembly spacing, safety and appearance - and the protection circuits, materials and components, thermal design, fire protection and installation. It took effect on 1 March 2024.

This document provides guidance related to the safety characteristics of battery in the design of lithium ion battery, and suggestions for improving product safety characteristics from the aspects of cells, protection circuits, materials and components, thermal design, fire protection and installation, etc. This document is applicable to the design of lithium ion battery, without distinguishing the fields of application.

2 Normative References

This document does not have normative references.

3 Terms and Definitions

The following terms and definitions are applicable to this document.

3.1 cell manufacturer Cell manufacturer refers to the manufacturer of lithium ion cells.

3.2 battery manufacturer Battery manufacturer refers to the manufacturer that assembles cells into batteries. NOTE: under certain circumstances, battery manufacturer may also be the cell manufacturer.

3.3 lithium ion cell Lithium ion cell refers to a device that relies on the movement of lithium ions between the positive and negative electrodes to realize the mutual conversion between chemical energy and electrical energy, and it is designed to be rechargeable. NOTE 1: the device usually includes electrodes, diaphragms, electrolytes, containers and terminals, etc. NOTE 2: hereinafter referred to as cell.

3.4 module Module refers to a configuration with multiple cells connected in series or parallel, with or without protection devices [for example, fuse protector or positive temperature coefficient thermistor (PTC)] and monitoring circuits. [source: IEC 62619:2017, 3.9]

3.5 battery protection circuit module; PCM battery management unit; BMU battery management system; BMS A circuit board, circuit module or electronic system with the core function of controlling the charging and discharging behavior of the battery to protect battery safety. NOTE 1: usually in the simple application field of portable products, a separate battery protection circuit module is used to protect the cells, while in the component module of complex battery systems, the battery management unit is adopted to manage the cells in the module; in complex battery systems, for example, new energy vehicle power batteries, the battery management system is adopted to realize the management and protection of the cells. NOTE 2: a complex battery management system may include cell voltage, temperature and current measurement, energy balance, SOC calculation and display, abnormal alarm, charge and discharge management, and communication, etc.

3.6 battery Battery system Battery system refers to a system consisting of one or multiple cells, modules or battery packs. It has a battery management system. If overcharge, overcurrent, over-discharge or overheating occurs, the battery management system will take action. NOTE 1: if the cell manufacturer and the user reach an agreement, over-discharge cut-off is not mandatory. NOTE 2: it may include cooling or heating devices, and some even include charge and discharge modules and inverter modules. [source: IEC 62619:2017, 3.11]

3.7 large lithium ion battery Large lithium ion battery refers to lithium ion battery with a total mass exceeding 12 kg. [source: UN 38.3 (Sixth revised edition), 2.3] NOTE: it is referred to as large battery in this document. a relatively large nominal capacity shall be carefully selected to ensure the safety, and necessary protection devices shall be equipped.

6.3 Cell Consistency Before assembly, the consistency of the cells needs to be screened (considering capacity, internal resistance and voltage, etc.); cells of the same brand, model

and specifications should be used, otherwise, they must satisfy the safety requirements of international standards, national standards and industry standards related to cell consistency.

6.4 Cell Quantity In order to reduce safety risks, the maximum quantity of cells connected in series or parallel in the battery respectively shall not exceed the quantity recommended by the cell manufacturer.

6.5 Cell Assembly Gap In the structural design of the battery, for cells with square structures and polymer (including liquid flexible package) structures, sufficient expansion space shall be reserved on the largest surface of the cells. The reserved expansion space shall be at least greater than the minimum value recommended by the cell manufacturer.

6.6 Cell Safety The safety of cells used by the battery manufacturer must satisfy the international standards, national standards and industry standards related to cells.

6.7 Cell Appearance Before assembly, check the appearance of the cells. The appearance of the cells shall comply with the stipulations of the battery manufacturer. The surface shall be clean and without mechanical damage.

7 Protection Circuit

7.1 Overview When lithium ion cells encounter abnormal conditions, such as: charging overvoltage, discharging undervoltage, charging overcurrent, discharging overcurrent and external short- circuit, etc., or are charged and discharged under extreme environmental conditions, or the charge and discharge rate exceeds their own capabilities in actual application environments, safety risks may arise. In the design of batteries, the above-mentioned risks shall be proactively addressed to protect the safety of the constituent cells. The modes of dealing with the above-mentioned risks include actively stopping charging and discharging behavior or controlling charging and discharging behavior within the safety range specified by the manufacturer. Priority should be given to the circuit function design to respond to the above-mentioned safety considerations, that is, to design a protection circuit that can control the charging and discharging behavior of the battery, for example, adding PCM/BMU/BMS to the battery. Priority shall be given to design of the above-mentioned protection circuit in the battery. If the above-mentioned protection circuit is only designed in the system equipment circuit and a battery without its own protection circuit is used, then, it is not appropriate to design the system's battery as a user-replaceable structure. In order to achieve a complete protection function, considerations may be given to adding necessary information collection devices to the battery. Necessary communication and control buses can be added to the connection between the battery and the equipment. In certain scenarios (for example, on the premise of ensuring personal and property safety), the system control circuit can respond to the protection strategy.