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(BAJ/JSA)

**Secondary lithium cells and
batteries for use in industrial
applications—Part 2: Tests and
requirements of safety**

ICS 29.220.99

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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Battery Association of Japan (BAJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 8715-2:2012** is replaced with this Standard.

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Attention is drawn to the possibility that some parts of this Standard may conflict with patent rights, applications for a patent after opening to the public or utility model rights. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying any of such patent rights, applications for a patent after opening to the public or utility model rights.

JIS C 8715 series consists of the following 2 parts under the general title *Secondary lithium cells and batteries for use in industrial applications*:

Part 1: Tests and requirements of performance

Part 2: Tests and requirements of safety

Secondary lithium cells and batteries for use in industrial applications— Part 2: Tests and requirements of safety

Introduction

This Japanese Industrial Standard has been prepared based on **IEC 62619:2017**, Edition 1, with some modifications of the technical contents taking into consideration the usage state of target secondary batteries in Japan.

The dotted underlines indicate changes from the corresponding International Standard. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies requirements and tests for the safe operation of secondary lithium cells and batteries (hereafter referred to as cells and batteries, respectively) used in industrial applications including stationary applications.

When there exists a **JIS** or **IEC** standard specifying test conditions and requirements for cells used in special applications and which is in conflict with this Standard, the former takes precedence (e.g. **IEC 62660** series on cells for the propulsion of electric road vehicles).

This Standard is applicable to the secondary lithium cells and batteries for stationary application and mobile application for industrial use. Practical examples for main applications are as follows.

- a) **Stationary applications:** telecom, uninterruptible power supplies (UPS), electrical energy storage system, emergency power and similar applications.
- b) **Motive applications:** fork-lift truck, golf cart, automated guided vehicle (AGV), railway, marine, etc., excluding road vehicles.

NOTE 1 Some secondary lithium cells and batteries are intended for portable devices. The safety of such secondary lithium cells and batteries are specified in **JIS C 8712**.

Since this Standard covers batteries for various industrial applications, it includes those requirements, which are common and minimum to the various applications.

Electrical safety is included only as a part of the risk assessment of Clause 8. In regard to details for risk assessment, the end use application standard requirements have to be considered.

This Standard applies to cells and batteries. If the battery is divided into smaller units, the smaller unit can be tested as the representative of the battery. The manufacturer clearly declares the tested unit. The manufacturer may add functions, which are present in the final battery, to the tested unit.

The requirements of performance and marking for secondary lithium cells and batteries for use in industrial applications are specified in **JIS C 8715-1**.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 62619:2017 *Secondary cells and batteries containing alkaline or other non-acid electrolytes—Safety requirements for secondary lithium cells and batteries, for use in industrial applications* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent editions (including amendments) shall be applied.

JIS C 8712:2015 *Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

NOTE Corresponding International Standard: IEC 62133:2012 *Secondary cells and batteries containing alkaline or other non-acid electrolytes—Safety requirements for portable sealed secondary cells, and for batteries made from them, for use in portable applications*

JIS C 8715-1:2018 *Secondary lithium cells and batteries for use in industrial applications—Part 1: Tests and requirements of performance*

NOTE Corresponding International Standard: IEC 62620:2014 *Secondary cells and batteries containing alkaline or other non-acid electrolytes—Secondary lithium cells and batteries for use in industrial applications*

JIS Z 8051 *Safety aspects—Guidelines for their inclusion in standards*

NOTE Corresponding International Standard: ISO/IEC Guide 51 *Safety aspects—Guidelines for their inclusion in standards*

3 Terms and definitions

For the purpose of this Standard, the terms and definitions given in **JIS Z 8051**, and the following apply.

3.1

safety

freedom from unacceptable risk

3.2

risk

a combination of the probability of occurrence of harm and the severity of that harm

3.3

harm

physical injury or damage to the health of people or damage to property or to the environment

3.4

hazard

potential source of harm

3.5

intended use

use of a product in accordance with specifications, instructions or information provided by the supplier

3.6

reasonably foreseeable misuse

use of a product in a way which is not intended by the supplier, but which may result from readily predictable human behaviour

3.7

cell, secondary lithium cell

secondary cell where electrical energy is derived from the insertion/extraction reactions of lithium ions or oxidation/reduction reaction of lithium between the negative electrode and the positive electrode

NOTE The cell typically has an electrolyte that consists of a lithium salt and organic solvent compound in liquid, gel or solid form and has a metal or a laminate film casing. It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.8

cell block

group of cells connected together in parallel configuration

It is a type of modules and a component alternatively used for the test of a cell, with or without protective devices [e.g. fuse or positive temperature coefficient (PTC)] and monitoring circuitry at the connection part.

NOTE It is not ready for use in an application because it is not yet fitted with its final housing, terminal arrangement and electronic control device.

3.9

module

group of cells connected together either in a series and/or parallel configuration with or without protective devices, (e.g. fuse or PTC) and monitoring circuitry

3.10

battery pack

energy storage device, which is comprised of one or more cells or modules electrically connected

NOTE 1 It may have a monitoring circuitry which provides information (e.g. cell voltage) to a battery system.

NOTE 2 It may incorporate a protective housing and be provided with terminals or other interconnection arrangement.

3.11

battery system, battery

system which comprises one or more cells, modules or battery packs

NOTE 1 It has an electronic system to control the current in case of overcharge, overcurrent, overdischarge, and overheating.

NOTE 2 Overdischarge cut off is not mandatory if there is an agreement between the cell manufacturer and the customer.

NOTE 3 The battery system may have cooling or heating units. Two or more battery systems may constitute a larger battery system. Battery system is also referred to as secondary battery.

3.12

battery management system, BMS

electronic system associated with a battery which has functions to control the current in case of overcharge, overcurrent, overdischarge, and overheating of battery system

NOTE 1 It monitors and/or manages the state of cell, calculates secondary data, reports that data and/or controls its environment to influence the battery's safety, performance and/or service life.

NOTE 2 Overdischarge cut off is not mandatory if there is an agreement between the cell manufacturer and the customer.

NOTE 3 The function of the BMS can be assigned to the battery system or to equipment that uses the battery (see Figure 5).

NOTE 4 The battery system may include the BMS function in the application side.

NOTE 5 The BMS is sometimes also referred to as a battery management unit (BMU).

3.13

leakage

visible escape of liquid electrolyte from a cell

3.14

venting

release of excessive internal pressure from a cell, module, battery pack, or battery system so that a gas exhaust valve functions in a manner intended by design to preclude rupture or explosion

3.15

rupture

mechanical failure of a cell container or the casing of module, battery pack or battery system induced by an internal or external cause, resulting in exposure or spillage but not ejection of materials

3.16

explosion

failure that occurs when a cell container or the casing of module, battery pack or battery system opens violently and solid components are forcibly expelled

NOTE Of the solid components, liquid, gas, and smoke are excluded.

3.17

fire

emission of flames from a cell, module, battery pack, or battery system

3.18

rated capacity

capacity value of a cell or battery determined under specified conditions and declared by the manufacturer, C_n (ampere-hours, Ah)

NOTE The rated capacity is the quantity of electricity C_n Ah (ampere-hours) which a single cell or battery can deliver during an n -hour period when charging, storing and discharging under the conditions specified in **JIS C 8715-1: 2018, 6.3.1.**

3.19

upper limit charging voltage

the highest charging voltage in the cell operating region specified by the cell manufacturer from a safety viewpoint

3.20

maximum charging current

the maximum charging current in the cell operating region which is specified by the cell manufacturer from a safety viewpoint

3.21

thermal runaway

occurrence or a state of uncontrolled intensive increase in the temperature of a cell driven by the positive feedback of exothermic reaction

3.22

lower limit discharging voltage

the lowest discharging voltage in the cell operating region which is specified by the cell manufacturer from a safety viewpoint

4 Parameter measurement tolerances

The overall accuracy of controlled or measured values of the test apparatus, relative to the specified or actual parameters, shall be within these tolerances.

- a) For voltage: $\pm 0.5 \%$
- b) For current: $\pm 1 \%$
- c) For temperature: $\pm 2 ^\circ\text{C}$
- d) For time: $\pm 0.1 \%$
- e) For mass: $\pm 1 \%$
- f) For dimensions: $\pm 1 \%$

These tolerances comprise the combined accuracy of the measuring instruments, the measurement techniques used, and all other sources of error in the test procedure.

The details of the instrumentation used shall be provided in any report of results.

5 General safety considerations

5.1 General

The safety of lithium secondary cells and batteries requires the consideration of two sets of applied conditions:

- a) intended use;
- b) reasonably foreseeable misuse.

Cells and batteries shall be so designed and constructed that they are safe under conditions of both **a)** and **b)** above. It may also be expected that cells and batteries subjected to intended use shall not only be safe but shall continue to be functional in all respects.

It is expected that cells or batteries subjected to reasonably foreseeable misuse may fail to function. However, even if such a situation occurs, they shall not present any significant hazards given in **1)** to **5)**.

- 1) Fire
- 2) Burst/explosion
- 3) Electrical short-circuit due to leakage of cell electrolyte
- 4) Venting which continuously vents out flammable gases
- 5) Rupture of a cell container or the casing of module, battery pack, or battery system with exposure of internal components

Conformity with **5.1** to **5.6** is checked by the tests of Clauses **6**, **7** and **8**, and in accordance with the appropriate standards (see Clause **2**).

For the mitigation of risks of causing injury to a human body, proper design shall be provided or other measures shall be taken for the movable part and the installation of the movable part to equipment.

5.2 Insulation and wiring

Internal wiring and its insulation shall be sufficient to withstand the maximum anticipated voltage, current, temperature, altitude and humidity requirements. The design of wiring shall be such that adequate clearances and creepage distances are maintained between conductors. The hazardous live part of battery system shall be adequately protected to prevent electric shock and to be safely installed to equipment. The mechanical integrity of the whole battery system (cell/module/BMS) and their internal connections shall be sufficient to accommodate conditions of reasonably foreseeable misuse.

5.3 Venting

The casing of a cell, module, battery pack, and battery system shall incorporate a venting function, i.e. a function that relieves the internal pressure before the internal pressure reaches the level that may cause rupture or explosion. If encapsulation is used to support cells within an outer case, the type of encapsulant and the method of encapsulation shall neither cause the battery system to overheat during normal operation nor inhibit pressure relief.

5.4 Temperature/voltage/current management

The design of batteries shall be such that abnormal temperature-rise conditions are prevented. Battery systems shall be designed within temperature, voltage and current limits specified by the cell manufacturer. Cell manufacturers shall provide specifications and charging instructions of battery systems for battery system manufacturers so that associated chargers are designed to maintain charging within the temperature, voltage and current limits specified.

NOTE Where applicable, means can be provided to limit current to safe levels during charge and discharge.

5.5 Terminal contacts of the battery pack and/or battery system

Terminals shall have clear polarity marking(s) [positive (+) or negative (-)] on the external surface of the battery pack or battery system.

NOTE Exception:

Battery packs with keyed external connectors designed for connection to specific end products need not be marked with polarity markings if the design of the external connector prevents reverse polarity connections.

The size and shape of the terminal contacts shall ensure that they can carry the maximum anticipated current. External terminal contact surfaces shall be formed from conductive materials with good mechanical strength and corrosion resistance. Terminal contacts shall be arranged so as to minimize the risk of short-circuits by e.g. metal tools.

5.6 Assembly of cells, modules, or battery packs into battery systems

5.6.1 General

The assembly of cells, modules, or battery packs to constitute the battery system shall respect the following rules in order to support adequate mitigation of risks into the battery system.

- Each battery system shall have an independent control and protection method(s).
- The cell manufacturer shall provide recommendations about current, voltage and temperature limits so that the battery system manufacturer/designer may ensure proper design and assembly.
- Batteries that are designed for the selective discharging of a portion of their series connected cells shall incorporate separate circuitry to prevent the cell reversal caused by uneven discharging.
- Protective circuit components may be added to the end-device application only when they function properly.

5.6.2 Battery system design

The voltage control function of the battery system design shall ensure that the voltage of each cell or cell block shall not exceed the upper limit charging voltage, except in the case where the stationary application devices or motive application devices provide an equivalent voltage control function.

For the battery system which has series-connected plural single cells, modules or battery packs, it is recommended that the voltages of any one of the single cells or cell blocks do not exceed the upper limit charging voltage, specified by the battery manufacturer. The voltage of every single cell or cell block connected in series should be measured.

5.7 Operating region of lithium cells and battery systems for safe use

The cell manufacturer shall specify the cell operating region. The battery manufacturer shall design the battery system to comply with the cell operating region. Determination of the cell operating region is explained in Annex A.

5.8 Quality plan

The battery system manufacturer shall prepare and implement a quality plan that defines procedures for the inspection of materials, components, cells, modules, battery packs, and battery systems and which covers the whole process of producing each type of cell, module, battery pack, and battery system (e.g. **JIS Q 9001**). Manufacturers of battery system should understand their process capabilities and should institute the necessary process controls as they relate to product safety.

6 Type test conditions

6.1 General

A cell used for the battery system that is used outside of its operating region may exhibit hazards resulting from the cells or batteries. Such risks have to be taken into consideration in order to prepare a safe test plan.

The type test facility should have a sufficient structural integrity and a fire suppression system to sustain the conditions of overpressure and fire that may occur as a result of testing. The facility should have a ventilation system to remove and capture gas which might be produced during the tests. Consideration should be given to high voltage hazards when applicable.

WARNING These tests in this Standard use procedures which may result in harm if adequate precautions are not taken. Tests should only be performed by qualified and experienced technicians using adequate protection. To prevent burns, caution should be taken for those cells or batteries whose casings may exceed 75 °C as a result of testing.

6.2 Test items

Type tests are made with the number of cells or batteries for test items specified in Table 1, using cells or batteries that have been stored under the conditions specified by the cell manufacturer and that are not more than six months old. Cells or batteries charged by the method specified in 7.1 shall deliver the rated capacity or more when they are discharged in an ambient temperature of $25\text{ °C} \pm 5\text{ °C}$, at a constant current of $0.2 I_t$ A, down to a specified final voltage. This capacity confirmation may be done in the manufacturer shipping inspection. In the case of a battery, the capacity may be calculated on the basis of the cell capacity measurements during the inspection performed by the cell manufacturer before shipping.

Unless otherwise specified, tests are carried out in an ambient temperature of $25\text{ °C} \pm 5\text{ °C}$.

NOTE Test conditions are for type tests only and do not imply that intended use includes operation under these conditions. Similarly, the limit of six months after manufacture is introduced for an improvement of test reproducibility and does not imply that cell and battery system safety is reduced after six months.