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Foreword

This Japanese Industrial Standard has been revised by the Minister of Economy, Trade and Industry based on the provision of Article 14, paragraph (1) of the Industrial Standardization Act applied mutatis mutandis pursuant to the provision of Article 16 of the said Act in response to a proposal for revision of Japanese Industrial Standard with a draft being attached, submitted by Japanese Standards Association (JSA), an accredited standards development organization. This edition replaces the previous edition (**JIS C 8500 : 2017**), which has been technically revised.

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Primary batteries — General

Introduction

This Japanese Industrial Standard has been prepared based on **IEC 60086-1** : 2021, Edition 13, with some modifications of the technical contents due to operational circumstances in Japan.

In this Standard, subclause numbers followed by a capital letter of Latin alphabet starting with “A” indicate that the subclause includes items not given in the corresponding International Standard, and vertical lines on both sides and dotted underlines are omitted.

The vertical lines on both sides and 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 for primary batteries with respect to electrochemical systems, dimensions, nomenclature, terminal configurations, markings, test methods, typical performance, safety, etc.

For primary batteries, **JIS C 8513** and **JIS C 8514** are available as safety standards, and **JIS C 8515** as an individual product standard.

Requirements for the battery and electrochemical system conforming to **JIS C 8513**, **JIS C 8514**, **JIS C 8515** and this Standard are specified in Annex A.

NOTE 1 A checklist for ensuring conformity with this Standard is given in Annex H.

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

IEC 60086-1 : 2021 *Primary batteries — Part 1 : General* (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

Part or all of the provisions of the following standards, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 8513 *Safety of primary lithium batteries*

NOTE Normative reference in the corresponding International Standard : IEC 60086-4 *Primary batteries — Part 4 : Safety of lithium batteries*

JIS C 8514 *Safety of primary batteries with aqueous electrolyte*

NOTE Normative reference in the corresponding International Standard : IEC 60086-5 *Primary batteries — Part 5 : Safety of batteries with aqueous electrolyte*

JIS C 8515 *Primary batteries — Physical and electrical specifications*

NOTE Normative reference in the corresponding International Standard : IEC 60086-2 *Primary batteries — Part 2 : Physical and electrical specifications*

3 Terms and definitions

For the purpose of this Standard, the following terms and definitions apply.

3.1

application test

simulation of the actual use of a battery in a specific application (e.g. portable light, radio)

3.2

battery

one or more cells electrically connected and fitted in a case, with terminals, markings and protective devices, etc., as necessary for use

(Source : IEC 60050-482 : 2004, 482-01-04, modified)

3.3

button (cell or battery)

small round cell or battery where the overall height is less than the diameter, containing aqueous electrolyte

Note 1 to entry Batteries with the shape categorized as Category 3 and Category 4 batteries in JIS C 8515 fall under this category.

Note 2 to entry The overall height is illustrated as h_1 in JIS C 8515, Clause 8.

(Source : IEC 60050-482 : 2004, 482-02-40)

3.4

cell

basic functional unit, consisting of an assembly of electrodes, electrolyte, container, terminals and usually separators, that is a source of electric energy obtained by direct conversion of chemical energy

(Source : IEC 60050-482 : 2004, 482-01-01)

3.5

closed-circuit voltage, CCV

voltage across the terminals of a battery when it is on discharge

(Source : IEC 60050-482 : 2004, 482-03-28, modified)

3.6

coin (cell or battery)

small round cell or battery where the overall height is less than the diameter, containing non-aqueous electrolyte

Note 1 to entry The nominal voltage of lithium batteries is typically greater than 2 V.

Note 2 to entry The overall height is illustrated as h_1 in JIS C 8515, Clause 8.

(Source : IEC 60050-482 : 2004, 482-02-40, modified)

3.7

cylindrical (cell or battery)

cylindrical cell or battery in which the overall height is equal to or greater than the diameter

Note 1 to entry The overall height is illustrated as h_1 in JIS C 8515, Clause 8.

(Source : IEC 60050-482 : 2004, 482-02-39, modified)

3.8

discharge (of a primary battery)

operation during which a battery delivers current to an external circuit

3.9

dry (primary) battery

primary battery in which the liquid electrolyte is essentially immobilized

(Source : IEC 60050-482 : 2004, 482-04-14, modified)

3.10

end-point voltage, EV

closed-circuit voltage of a battery at which the battery discharge is terminated

(Source : IEC 60050-482 : 2004, 482-03-30)

3.11

leakage

unplanned escape of electrolyte, gas or other material from a cell or battery

Note 1 to entry Leakage in this sense should not be confused with the test evaluation criteria for leakage specified in Clause 4 and Clause 5 of this Standard.

(Source : IEC 60050-482 : 2004, 482-02-32)

3.12**minimum average duration, MAD**

minimum average time on discharge which is met by a sample of batteries

Note 1 to entry The discharge test is carried out according to the specified methods or standards and designed to show conformity with the standard applicable to the battery types.

3.13**nominal voltage (of a primary battery), U_n**

battery voltage specified on the basis of the voltage determined by an electrochemical system (materials used such as positive electrode, negative electrode and electrolyte)

(Source : IEC 60050-482 : 2004, 482-03-31, modified)

3.14**open-circuit voltage, OCV**

voltage across the terminals of a cell or battery when it is off discharge

3.15**primary (cell or battery)**

cell or battery that is not designed to be electrically recharged

Note 1 to entry Primary batteries are also referred to as batteries.

(Source : IEC 60050-482 : 2004, 482-01-02, modified)

3.16**round (cell or battery)**

cell or battery with circular cross section

(Source : IEC 60050-482 : 2004, 482-04-17, modified)

3.17**service output (of a primary battery)**

service life, or capacity, or energy output of a battery under specified conditions of discharge

3.18**service output test**

test designed to measure the service output of a battery

Note 1 to entry A service output test may be prescribed, for example, when

- a) an application test is too complex to replicate;
- b) the duration of an application test would make it impractical for routine testing purposes.

3.19

storage life

duration under specified conditions at the end of which a battery retains its ability to perform a specified service output

(Source : IEC 60050-482 : 2004, 482-03-47, modified)

3.20

terminals (of a primary battery)

conductive parts of a battery that provide connection to an external circuit

4 Requirements

4.1 General

4.1.1 Design

Primary batteries are sold mainly in consumer markets. In recent years, they have become more sophisticated in both chemistry and construction, for example both capacity and rate capability have increased to meet the growing demands from new, battery-powered equipment technology.

When designing primary batteries, the aforementioned considerations shall be taken into account. Specifically, their dimensional conformity and stability, their physical and electrical performance and their safe operation under normal use and foreseeable misuse conditions shall be assured.

Additional information on equipment design can be found in Annex B.

4.1.2 Battery dimensions

The dimensions for individual types of batteries are given in **JIS C 8515**.

4.1.3 Terminals

4.1.3.1 General

Terminals shall be in accordance with Clause 8 of **JIS C 8515**.

Their physical shape shall be designed in such a way that they ensure that the batteries make and maintain good electrical contact at all times. They shall be made of materials that provide good electrical conductivity and resistance to corrosion.

For types and definitions of terminals, see **4.1.3.3** to **4.1.3.11**.

4.1.3.2 Contact pressure resistance

Where stated in the battery specification tables or the individual specification sheets in **JIS C 8515**, Clause 8, the following applies :

- a force of 10 N applied through a steel ball of 1 mm diameter at the centre of each contact area for a period of 10 s shall not cause any apparent deformation which might prevent satisfactory operation of the battery.

4.1.3.3 Cap and base

This type of terminal is used for batteries which have the cylindrical side of the battery insulated from the terminals.

4.1.3.4 Cap and case

This type of terminal is used for batteries in which the cylindrical side of the battery forms part of the positive terminal.

4.1.3.5 Screw terminals

This contact consists of a threaded rod in combination with either a metal or insulated metal nut.

4.1.3.6 Flat contacts

These are essentially flat metal surfaces adapted to make electrical contact by suitable contact mechanisms bearing against them.

4.1.3.7 Flat or spiral springs

These contacts comprise flat metal strips or spirally wound wires which are in a form that provides pressure contact.

4.1.3.8 Plug-in-sockets

(Entry deleted as unnecessary in JIS.)

4.1.3.9 Snap fasteners

4.1.3.9.1 General

These contacts are composed of a combination comprising a stud (non-resilient) for the positive terminal and a socket (resilient) for the negative terminal.

They shall be of suitable metal so as to provide efficient electrical connection when joined to the corresponding parts of an external or electrical circuit.

4.1.3.9.2 Snap fastener

This type of terminal consists of a stud for the positive terminal and a socket for the negative terminal. These shall be made from nickel plated steel or other suitable material. They shall be designed to provide a secure physical and electrical connection, when fitted with similar corresponding parts for connection to an electrical circuit.

4.1.3.10 Wire

Wire leads may be single or multi-strand flexible insulated tinned copper. The positive terminal wire covering shall be red and the negative black.

4.1.3.11 Other spring contacts or clips

These contacts are generally used on batteries when the corresponding parts of the external circuit are not precisely known. They shall be of spring brass or of other material having similar properties.

4.1.4 Classification (electrochemical system)

Primary batteries are classified according to their electrochemical system (combination of negative electrode, electrolyte and positive electrode).

Each system, with the exception of manganese dry batteries, has been allocated a letter denoting the particular system. The electrochemical systems that have been standardized up to now are given in Table 1.

Table 1 Classification of electrochemical systems

Electrochemical system letter	Electrochemical system designation (reference)	Negative electrode	Electrolyte	Positive electrode	Nominal voltage U_n V	Maximum open-circuit voltage V
No letter	Manganese (dry) battery	Zinc (Zn)	Ammonium chloride, zinc chloride, water	Manganese dioxide (MnO_2)	1.5	1.73
A	Wet air cell	Zinc (Zn)	Ammonium chloride, zinc chloride, water	Oxygen (O_2)	1.4	1.55
B	Graphite fluoride lithium primary battery	Lithium (Li)	Lithium salt, organic electrolyte	Graphite fluoride $[(CF)_n]$	3.0	3.7
C	Manganese dioxide lithium primary battery	Lithium (Li)	Lithium salt, organic electrolyte	Manganese dioxide (MnO_2)	3.0	3.7
E	Thionyl chloride lithium primary battery	Lithium (Li)	Lithium salt, non-aqueous inorganic	Thionyl chloride ($SOCl_2$)	3.6	3.9
F	Iron disulfide lithium primary battery	Lithium (Li)	Lithium salt, organic electrolyte	Iron disulfide (FeS_2)	1.5	1.83
G	Copper oxide lithium primary battery	Lithium (Li)	Lithium salt, organic electrolyte	Copper (II) oxide (CuO)	1.5	2.3
L	Alkaline manganese battery ^{a)}	Zinc (Zn)	Alkali metal hydroxide, water	Manganese dioxide (MnO_2)	1.5	1.68
P	Zinc air battery	Zinc (Zn)	Alkali metal hydroxide, water	Oxygen (O_2)	1.4 or 1.45	1.59
S	Silver oxide battery	Zinc (Zn)	Alkali metal hydroxide, water	Silver oxide (Ag_2O)	1.55	1.63
W	Sulfur dioxide lithium primary battery	Lithium (Li)	Lithium salt, organic electrolyte	Sulfur dioxide (SO_2)	3.0	3.05
Y	Sulfuryl chloride lithium primary battery	Lithium (Li)	Lithium salt, non-aqueous inorganic	Sulfuryl chloride (SO_2Cl_2)	3.9	4.1
Z	Nickel zinc primary battery	Zinc (Zn)	Alkali metal hydroxide, water	Nickel oxyhydroxide ($NiOOH$)	1.5	1.78
NOTE 1 The value of the nominal voltage is not verifiable; therefore it is only given as a reference. NOTE 2 The maximum open-circuit voltage (3.14) is measured as defined in 5.5 and 6.8.1. NOTE 3 [The corresponding International Standard describes the English electrochemical system nomenclature rules in this NOTE, but this is not necessary in this Standard and has been deleted.] NOTE 4 Reference to the electrochemical systems of this table usually appears in a simplified form, for example, “B- and C-system batteries” or “manganese battery”. Note ^{a)} Alkaline manganese batteries are classified into button, cylindrical and non-round; cylindrical and non-round batteries are called alkaline manganese dry batteries.						

4.1.5 Battery nomenclature

Batteries are designated according to the type of batteries. The designation of primary batteries (hereafter referred to as battery nomenclature) is based on their physical parameters, their electrochemical system, as well as modifiers, if needed.

The battery nomenclature shall be as given in Annex C.

4.1.6 Marking

4.1.6.1 General

For an overview of marking requirements, refer to Table 2. With the exception of batteries too small to mark with all items (see 4.1.6.2), each battery shall be marked with the information in a) to f), and the information in g) should preferably be marked:

- a) designation or common designation from which the designation can be identified;
- b) expiration of a recommended usage period (year and month) or date of manufacture (year and month), or its abbreviation;
- c) polarity of the positive (+) terminal;
- d) nominal voltage;
- e) name or trade mark of the manufacturer or supplier, or its abbreviation;
- f) cautionary advice;
- g) electrochemical system designation or abbreviation.

NOTE Examples of the common designations can be found in Annex D of JIS C 8515.

4.1.6.2 Marking of smaller batteries

- a) Some batteries categorized as Category 3 and Category 4 batteries in JIS C 8515 have a surface too small to accommodate all markings shown in 4.1.6.1. For these batteries, the designation or common designation from which the designation can be identified in 4.1.6.1 a) and the polarity of positive (+) terminal in 4.1.6.1 c) shall be marked on the battery. All other markings shown in 4.1.6.1 may be given on the immediate packing if they cannot be marked on the battery.
- b) For P-system batteries, 4.1.6.1 a) may be on the battery, the sealing tab or the immediate packing. 4.1.6.1 c) may be marked on the sealing tab and/or on the battery. 4.1.6.1 b), 4.1.6.1 d) and 4.1.6.1 e) may be given on the immediate packing instead of on the battery. The nominal voltage may be marked either 1.4 V or 1.45 V.
- c) Caution for ingestion of swallowable batteries shall be given. Refer to current valid versions of JIS C 8513 and JIS C 8514 for details.

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Table 2 Marking items and marking positions

Marking item	Marking position		
	Batteries capable of accommodating all markings	Batteries too small to accommodate all markings	
		Other than P-system batteries	P-system batteries
a) Designation or common designation from which the designation can be identified	A	A	C
b) Expiration of a recommended usage period ^{a)} or date of manufacture ^{b)}	A	B	B
c) Polarity of the positive (+) terminal	A	A	D
d) Nominal voltage	A	B	B ^{c)}
e) Name or trade mark of the manufacturer or supplier, or its abbreviation	A	B	B
f) Cautionary advice	A	B ^{d)}	B ^{d)}
g) Electrochemical system designation or abbreviation ^{e)} (recommended)	A	B	B
Key A : shall be marked on the battery. B : may be marked on the immediate packing instead of on the battery. C : may be marked on the battery, the sealing tab or the immediate packing. D : may be marked on the sealing tab and/or on the battery. Note ^{a)} Expiration of a recommended usage period is indicated by “expiration of recommended usage period (month-year)” followed by the month in two digits and year in four digits of the expiration of recommended usage period. The year is indicated in abbreviated format by the last two digits of the year. Other characters may be given after the year and month or abbreviation. Marking examples for an expiration of a recommended usage period of April 2026 are as follows. Example 1 Expiration of recommended usage period (month-year) 04-2026 Example 2 Expiration of recommended usage period (month-year) 04-26 If the year and month, or abbreviation of the expiration of recommended usage period is indicated separately apart from the indication of “expiration of recommended usage period (month-year)”, indicate to that effect. Note ^{b)} The date of manufacture is indicated by the indication “date of manufacture (year-month)” followed by the year and month or abbreviation, following the indication of the expiration of recommended usage period. Note ^{c)} The nominal voltage may be marked either 1.4 V or 1.45 V. Note ^{d)} Caution for ingestion of swallowable batteries shall be given. Refer to current valid versions of JIS C 8513 and JIS C 8514 for details. Note ^{e)} Examples of abbreviations are as follows. Example 1 Manganese battery : “no-letter” system Example 2 Lithium battery : systems B, C, E, F, G, W and Y Example 3 Alkaline (dry) battery : system L Example 4 Air battery : system P Example 5 Silver battery : system S English text of equivalent meaning may be used.			

4.1.7 Interchangeability: battery voltage

Primary batteries can be categorized by their standard discharge voltage U_s . For a

new battery system, its interchangeability by voltage is assessed for compliance with the following equation :

$$n \times (U_r \times 0.85) \leq m \times U_s \leq n \times (U_r \times 1.15)$$

where, n : number of cells connected in series, based on reference voltage U_r
 m : number of cells connected in series, based on standard discharge voltage U_s
 U_r : reference voltage (V)
 U_s : standard discharge voltage (V)

NOTE 1 The sign “ $\leq$ ” between m and U_s in the corresponding International Standard is replaced by “ $\times$ ”.

Currently, two voltage ranges that conform to the above equation have been identified. They are identified by reference voltage U_r , which is the midpoint of the relevant voltage range.

- **Voltage range 1**, reference voltage $U_r = 1.40$ (V) : Batteries having a standard discharge voltage $m \times U_s$ equal to or within the range of $n \times 1.19$ V to $n \times 1.61$ V.
- **Voltage range 2**, reference voltage $U_r = 3.20$ (V) : Batteries having a standard discharge voltage $m \times U_s$ equal to or within the range of $n \times 2.72$ V to $n \times 3.68$ V.

Details on the standard discharge voltage U_s and related quantities, as well as the methods of their determination, are given in Annex D.

NOTE 2 For single-cell batteries and for multi-cell batteries assembled with cells of the same voltage range, m and n will be identical; m and n will be different for multi-cell batteries if assembled with cells from a different voltage range than those of an already standardized battery.

Voltage range 1 encompasses all presently standardized batteries with a nominal voltage of about 1.5 V, i.e. “no-letter” system, systems A, F, G, L, P, S and Z.

Voltage range 2 encompasses all presently standardized batteries with a nominal voltage of about 3 V, i.e. systems B, C, E, W and Y.

Because batteries from Voltage range 1 and Voltage range 2 show significantly different discharge voltages, they shall be designed to be physically non-interchangeable. Before standardizing a new electrochemical system other than that specified in Table 1, its standard discharge voltage shall be determined in accordance with the procedure given in Annex D to resolve its interchangeability by voltage.

WARNING Failure to comply with this requirement can present safety hazards to the user, such as fire, explosion, leakage and/or device damage. This requirement is necessary for safety and operational reasons.

4.2 Performance

4.2.1 Discharge performance

Discharge performance of primary batteries is specified in **JIS C 8515**.