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**Safety of primary batteries with
aqueous electrolyte**

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Contents

	Page
Introduction.....	1
1 Scope	1
2 Normative references	1
3 Terms and definitions	2
4 Requirements for safety	3
4.1 Design	3
4.2 Quality plan	4
5 Sampling	4
5.1 General	4
5.2 Sampling for type approval	4
6 Testing and requirements.....	5
6.1 General	5
6.2 Intended use	6
6.3 Reasonably foreseeable misuse	9
7 Information for safety	11
7.1 Safety precautions during handling of batteries	11
7.2 Packaging	13
7.3 Handling of battery cartons	14
7.4 Display and storage	14
7.5 Transportation	14
7.6 Disposal	14
8 Instructions for use	15
9 Marking	15
9.1 General	15
9.2 Small batteries	15

Annex A (informative)	Additional information to the storage and stock rotation requirements.....	16
Annex B (informative)	Battery compartment design guidelines	17
Annex JA (informative)	Comparison table between JIS and corresponding International Standard	29
Bibliography		33

Foreword

This translation has been made based on the original Japanese Industrial Standard 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 8514**:2001 is replaced with this Standard.

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Safety of primary batteries with aqueous electrolyte

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **IEC 60086-5** published in 2005, with some modifications of the technical contents including addition of descriptions and reference to Japanese Industrial Standards not given in the said original International Standard, that are aimed to adapt the contents to the actual situation of Japan.

In addition, the portions underlined with dots in this Standard are the matters in which the contents of the original International Standard have been modified. A list of modifications with explanations is given in Annex JA.

1 Scope

This Standard specifies tests and requirements for primary batteries with aqueous electrolyte to ensure their safe operation under intended use and reasonably foreseeable misuse.

NOTE 1 Aqueous electrolyte primary batteries consist of 5 battery systems that are given symbols A, L, P, S, respectively, shown in table 1, including one without a symbol.

NOTE 2 The aim of this Standard is to specify the characteristics of primary batteries with aqueous electrolyte and it is not to be used, by itself, as a conformity assessment standard.

NOTE 3 The International Standard corresponding to this Standard and the symbol which denotes the degree of correspondence in the contents between **JIS** and the International Standard are as follows:

IEC 60086-5:2005 *Primary batteries—Part 5: Safety of batteries with aqueous electrolyte* (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**.

2 Normative references

The following standards contain provisions which, 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 8500 *Primary batteries—General*

NOTE : Corresponding International Standard: **IEC 60086-1:2000** *Primary batteries—Part 1: General* (MOD)

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

NOTE : Corresponding International Standard: **IEC 60086-2**:2000 *Primary batteries—Part 2: Physical and electrical specifications*, Amendment 1 (2001) and Amendment 2 (2004) (MOD)

JIS C 60068-2-6 *Environmental testing—Part 2: Tests—Test Fc: Vibration (sinusoidal)*

NOTE : Corresponding International Standard: **IEC 60068-2-6**:1995 *Environmental testing Part 2: Tests—Test Fc: Vibration (sinusoidal)* (IDT)

JIS 60068-2-27 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock*

NOTE : Corresponding International Standard: **IEC 60068-2-27**:1987 *Basic environmental testing procedures Part 2: Tests, Test Ea and guidance: Shock* (IDT)

JIS C 60068-2-32 *Environmental testing Part 2: Tests. Test Ed: Free fall*

NOTE : Corresponding International Standard: **IEC 60068-2-32**:1975 *Basic environmental testing procedures Part 2: Tests—Test Ed: Free fall*, Amendment 1 (1982) and Amendment 2 (1990) (IDT)

3 Terms and definitions

For the purposes of this Standard, the definitions given in **JIS C 8500** apply, together with the following definitions.

3.1 battery (primary)

one or more primary cells, including case, terminals and marking

3.2 button battery

small round battery, where the overall height is less than the diameter; batteries complying with category 3 or 4 specified in **JIS C 8515**

3.3 cell (primary)

source of electrical energy obtained by the direct conversion of chemical energy that is not designed to be charged by any other electrical source

3.4 cylindrical battery

primary battery with cylindrical geometry where the overall height is equal to or greater than the diameter; batteries complying with category 1, 2 or 5 specified in **JIS C 8515**

3.5 explosion (battery explosion)

an instantaneous release wherein solid matter from any part of the battery is propelled to a distance greater than 25 cm away from the battery

3.6 harm

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

3.7 hazard

potential source of harm

NOTE : The term hazard can be qualified in order to define its origin or the nature of the expected harm (e.g. electric shock hazard, crushing hazard, cutting hazard, toxic hazard, fire hazard, drowning hazard).

3.8 intended use

use of a battery in accordance with information provided by the supplier

3.9 leakage

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

3.10 nominal voltage

suitable approximate value of voltage used to identify the voltage of a primary battery (see table 1)

3.11 prismatic battery

primary battery with non-round geometry; batteries complying with category 6 specified in **JIS C 8515**

3.12 reasonably foreseeable misuse

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

3.13 risk

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

3.14 safety

freedom from unacceptable risk

3.15 venting

release of excessive internal pressure from a battery in a manner intended by design to preclude explosion

4 Requirements for safety

4.1 Design

4.1.1 General

Batteries shall be so designed that they do not present a safety hazard under conditions of normal (intended) use and reasonable foreseeable misuse.

4.1.2 Venting

All batteries shall incorporate a pressure relief feature or shall be so constructed that they will relieve excessive internal pressure at a value and rate which will preclude explosion. If encapsulation is necessary to support cells within an outer case, the

type of encapsulant and the method of encapsulation shall not cause the battery to overheat during normal operation nor inhibit the operation of the pressure relief feature.

The battery case material and/or its final assembly shall be so designed that, in the event of one or more cells venting, the battery case does not present a hazard in its own right.

4.1.3 Insulation resistance

The insulation resistance between externally exposed metal surfaces of the battery excluding electrical contact surfaces and either terminal shall be not less than $5 \text{ M}\Omega$ at $(500 \pm 50) \text{ V}$.

4.2 Quality plan

The manufacturer shall prepare a quality plan defining the procedures for the inspection of materials, components, cells and batteries during the course of manufacture, to be applied to the total process of producing a specific type of battery.

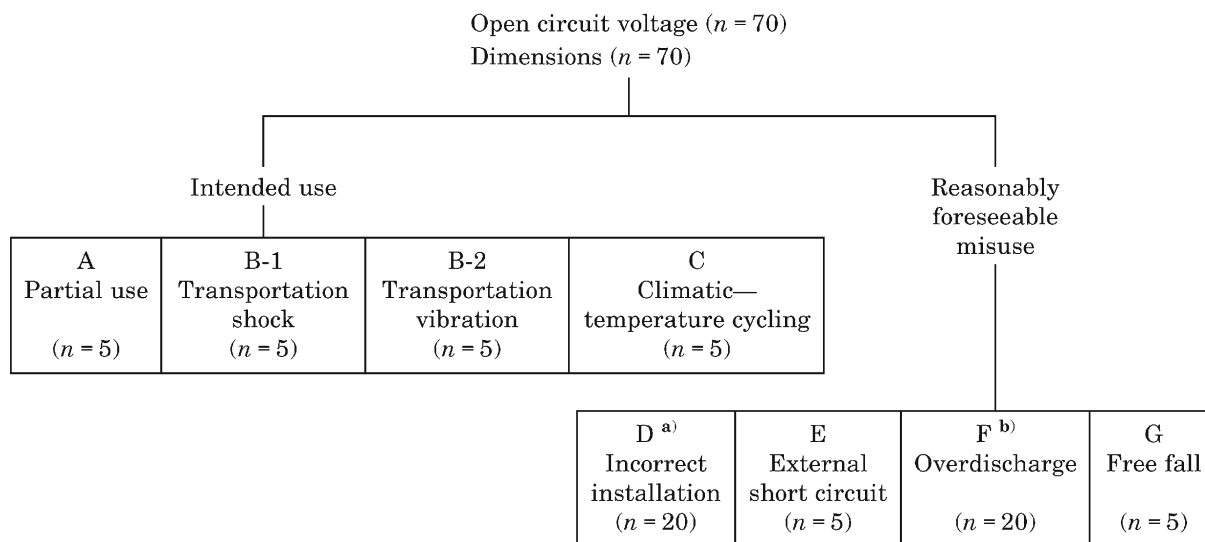
5 Sampling

5.1 General

Samples should be drawn from production lots in accordance with accepted statistical methods.

5.2 Sampling for type approval

The following number of samples (n) are drawn for type approval.



Notes ^{a)} Four batteries connected in series with one of the four batteries reversed (5 sets).

^{b)} Four batteries connected in series, one of which is discharged (5 sets).

Figure 1 Sampling for type approval tests and number of batteries required

6 Testing and requirements

6.1 General

Battery systems and applicable test methods are shown in table 1.

Tests described in tables 2 and 6 are intended to simulate conditions which the battery is likely to encounter during intended use and reasonably foreseeable misuse.

6.1.1 Safety notice

WARNING: These tests call for the use of procedures which may result in injury if adequate precautions are not taken.

It has been assumed in the drafting of these tests that their execution is undertaken by appropriately qualified and experienced technicians using adequate protection.

6.1.2 Ambient temperature

Unless otherwise specified, these tests shall be carried out at $(20 \pm 5) ^\circ\text{C}$.

Table 1 Battery systems and test matrix

System letter	Negative electrode	Electrolyte	Positive electrode	Nominal voltage per cell V	Form	Applicable tests						
						A	B-1 B-2	C	D	E	F	G
—	Zinc	Ammonium chloride Zinc chloride Water	Manganese dioxide (MnO ₂)	1.5	R	○	○	○	○	○	○	○
					B	NR						
					M	○	○	○	NR	○	○	○
A	Zinc	Ammonium chloride Zinc chloride Water	Oxygen (O ₂)	1.4	R	○	○	○	NR	○	○	○
					B	NR						
					M	○	○	○	NR	○	○	○
L	Zinc	Alkali metal hydroxide Water	Manganese dioxide (MnO ₂)	1.5	R	○	○	○	○	○	○	○
					B	○	○	○	NR	○	NR	○
					M	○	○	○	NR	○	NR	○
P	Zinc	Alkali metal hydroxide Water	Oxygen (O ₂)	1.4	R	NR						
					B	NR	○	○	NR	○	NR	○
					M	NR						
S	Zinc	Alkali metal hydroxide Water	Silver oxide (Ag ₂ O)	1.55	R	○	○	○	NR	○	NR	○
					B	○	○	○	NR	○	NR	○
					M	NR						
Test description: A: storage after partial use B-1: transportation shock B-2: transportation vibration C: climatic-temperature cycling D: incorrect installation E: external short circuit F: overdischarge G: free fall Key R: cylindrical (3.4) B: button (3.2) M: multicell ○: required NR: not required												
NOTE: Systems L and S button cells or batteries under 250 mAh capacity and system P button cells or batteries under 700 mAh capacity are exempt from any testing.												

6.2 Intended use

6.2.1 Intended use tests and requirements

Intended use tests and requirements shall be in accordance with table 2.

Table 2 Intended use tests and requirements

Test		Intended use simulation	Requirements
Electrical test	A	Storage after partial use	No leakage (NL) No explosion (NE)
Environmental tests	B-1	Transportation shock	No leakage (NL) No explosion (NE)
	B-2	Transportation vibration	No leakage (NL) No explosion (NE)
Climatic-temperature	C	Climatic-temperature cycling	No explosion (NE)

6.2.2 Intended use test procedures

6.2.2.1 Test A – Storage after partial use

- a) **Purpose** This test simulates the situation when an appliance is switched off and the installed batteries are partly discharged. These batteries may be left in the appliance for a long time or they are removed from the appliance and stored for a long time.
- b) **Test procedure** An undischarged battery is discharged under an application/service output test condition, with the lowest resistive load (excluding current load) test as defined in **JIS C 8515** until the service life falls by 50 % of the minimum average duration (MAD) value specified in **JIS C 8515**, followed by storage at $45\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for 30 days.
- c) **Requirements** There shall be no leakage and no explosion during this test.

6.2.2.2 Test B-1 – Transportation shock

- a) **Purpose** This test simulates the situation when an appliance is carelessly dropped with batteries installed in it. This test condition is generally specified in **JIS C 60068-2-27**.
- b) **Test procedure** An undischarged battery shall be tested as follows.
The shock test shall be carried out under the conditions defined in table 3 and the sequence given in table 4.
- c) **Requirements** There shall be no leakage and no explosion during this test.

Table 3 Shock pulse

Acceleration		Waveform
Minimum average acceleration first three milliseconds	Peak acceleration	
735 m/s ²	1 225 m/s ² to 1 715 m/s ²	Half sine

Table 4 Test sequence

Step	Storage time	Battery orientation	Number of shocks	Visual examination periods
1	—	—	—	Pre-test
2	—	a)	1 each	—
3	—	a)	1 each	—
4	—	a)	1 each	—
5	1 h	—	—	—
6	—	—	—	Post-test
Step 1 Record open circuit. Steps 2 to 4 Apply shock test specified in table 3 and the sequence in table 4. Step 5 Rest battery for 1 h. Step 6 Record examination results. Note a) The shock shall be applied in each of three mutually perpendicular directions (see figure 6).				

6.2.2.3 Test B-2 – Transportation vibration

- a) **Purpose** This test simulates vibration during transportation. This test condition is generally specified in **JIS C 60068-2-6**.
- b) **Test procedure** An undischarged battery shall be tested as follows.

Vibration – A simple harmonic motion shall be applied to the battery having an amplitude of 0.8 mm, with a total maximum excursion of 1.6 mm. The frequency shall be varied at the rate of 1 Hz/min between the limits of 10 Hz and 55 Hz. The entire range of frequencies (10 Hz to 55 Hz) and return (55 Hz to 10 Hz) shall be traversed in (90 ± 5) min for each mounting position (direction of vibration). The test sequence shall be as given in table 5.