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KOREAN INDUSTRIAL STANDARD

Small-size Sealed Lead-acid Batteries
(Valve Regulated Types)

KS C 8519 : 1999

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Introduction

This Korean Industrial Standard has been prepared based on IEC 61056-1 Portable Lead-acid Cells and Batteries (Valve-regulated types) Part 1: General Requirements, Functional Characteristics-Methods of Test, published in 1991 as the first edition, without any modification for the parts specified in the International Standard, but additionally includes items and contents not specified in the International Standard.

The portions underlined with dotted lines mean the matters not included in the corresponding International Standard. The IEC Standard number is based on the new numbering system of IEC Standards put in force in January 1st 1997, and the Standard published before the said date is numbered by adding 60000 to the former number. This is only the change in number and the contents remain unchanged.

1. Generals

1.1 Scope

This Korean Industrial Standard specifies the general requirements, functional characteristics and method of test of small-sized sealed lead-acid batteries (hereafter referred to as "batteries") for cycle service and those for trickle service which do not require water addition.

Remark The International Standard corresponding to this Standard is given below.

IEC 61056-1:1991 Portable Lead-acid Cells and Batteries
(Valve-Regu-Lated Types)

Part 1 : General Requirements, Functional Characteristics-
Methods of Test

Part 2 : Dimensions, Terminal and Marking

Part 3 : Safety Recommendations for Use in Electric
Appliances

1.2 Normative References

The following standards contain provisions which, through reference in this standard, constitute provisions of this standard. If the indication of the year of coming into effect is given to these referred standards, only the edition of indicated year constitutes the provision of this standard but the revision and amendment made thereafter are not applied. The normative references without the indication of the year of coming into effect apply limiting only to the most recent edition (including the amendment).

KS B 5203 Vernier Callipers

Remark ISO 3599 Vernier callipers reading to 0.1 and 0.05mm is corresponding to this Standard.

KS B 5302 Etched Stem Liquid-in-glass Thermometer

KS B 5305 Bourdon Tube Pressure Gauges

KS B 5312 Barographs

KS C 0210 Environmental Testing Procedures-General and Guidance

Remark IEC 60068-1:1988 Environmental testing. Part 1: General and guidance coincides with this standard.

KS C 1303 Electrical Indicating Instruments

KS C 1308 Direct-acting Electrical Recording Instruments

Remark IEC 60051:1984 Direct acting indicating analogue electrical measuring instruments and their accessories is corresponding to this Standard.

KS C 2624 Flat Quick-Connect Terminals

KS L 2317 1994 Volumetric Glassware

Remark ISO 384:1978 Laboratory glassware-Principles of design and construction of volumetric glassware,

ISO 385:1984 Laboratory glassware-Burettes and ISO 4787:1984 Laboratory glassware-Volumetric glassware-Methods for use and testing of capacity are corresponding to this Standard.

IEC 60417:1973 Graphical symbols for use on equipment. Index, survey and compilation of the single sheets

1.3 Definitions

For the purpose of this Standard the following principal definitions of terms shall apply:

a) small-sized sealed lead-acid batteries

Lead-acid batteries which functionally do not require water addition by means of such a system that the oxygen generated at positive plate is absorbed by negative plate by reaction in the battery, thus generation of hydrogen is suppressed due to chemically discharged state of negative plate. The batteries shall not cause electrolyte leakage under specified conditions, and be equipped with vent valves (for classification, see Annex 1).

b) nominal voltage

The standard voltage to be used for voltage marking of batteries.

c) rated capacity (20 hour rate)

The quantity of electricity (Ah) which can be taken out from a battery of full charge under specified conditions of temperature, discharge current and final voltage which is declared by the manufacturer as the reference value. The

numerical value of rated capacity at 20 hour rate is expressed by C_{20} .

d) capacity (20 hour rate)

The product of 20 hour-rate current and the time until the final voltage is reached, or the quantity of electricity (Ah) when the discharge is carried out at 20 hour-rate current until the final voltage is reached.

e) high rate discharge characteristics

The discharge characteristics when the discharge is carried out at a comparatively large current with the capacity of a battery.

f) overcharge characteristics

The characteristics which show the endurance of a battery to further charging after it has been fully charged (informative)

g) gas recombining efficiency

The efficiency at which the gas produced by decomposition of water is returned to water by means of absorption of oxygen on negative plate.

h) vent valve

The valve which does not allow external air to enter into the battery but shall allow gas to escape from the battery at a certain internal pressure which does not lead to damage of the battery.

i) storage characteristics

The characteristics which show the storage stability when a battery is allowed to stand for a long period.

j) cycle service

A service state of a battery in which discharging and charging are repeated alternately.

k) trickle service

A service state of a battery in which the battery is continuously charged at a very small current being disconnected from the load to compensate self discharge, to always stand by for unexpected discharge due to interruption of power service or the like.

l) life

The number of discharges or the years lapsed until such an instant that the capacity measured in accordance with the specified test method while the discharging and charging are carried out under the specified conditions, decreases to the specified capacity or below.

2. Classification

2.1 Classification

The batteries applicable to this standard shall be in accordance with Annex 1, Dimensions, Terminals and Marking.

2.2 Symbols

For the symbols corresponding to the physical magnitudes used in the numerical formulae and the provisions, there are cases of using different symbols to the same physical magnitudes due to the difference of the background that includes the description aspect in the International Standard and the added specifications. Therefore, this standard shall describe without standardizing of these symbols.

3. Safety Recommendations for Use in Electric Appliance

The batteries shall comply with Annex 2, Safety Recommendations for Use in Electric Appliances.

4. General Requirement

4.1 Construction

Batteries are composed of one or more cells. A cell is composed of flat plates accommodated in a square container or a pair of plates spirally wound accommodated in a cylindrical container. The electrolyte of these cells is fixed by such means that it is absorbed in porous structure located between electrodes or it forms a gell.

Multicell-batteries may be supplied either as monoblocks or as mechanically and electrically interconnected combinations of several single cells.

The number of cells in a battery is designated by the letter "*n*".

Batteries shall be fitted with control valves. The valve shall not allow gas (air) to enter into the cell but shall allow the gas to escape from the cell at a certain internal pressure which does not lead to deformation or other damage of the cell or battery container.

Batteries or cells shall be designed so that neither water nor electrolyte can be added.

Batteries for cycle service shall be suitable for operation in any orientation (e.g. upside down) without leakage of liquid from valves and or terminal seals.

Batteries for trickle service shall not be installed in an orientation exceeding 90° from the normal state.

All battery components like terminals, intercell connectors, containers, etc. shall be designed for current-rates as specified in 5.5.

4.2 Mechanical Strength

Batteries shall be designed to withstand mechanical stresses, vibrations and shocks occurring in normal transportation, handling and use.

4.3 Designation

At least the following items shall be adequately designated on each battery:

- a) Type designation
- b) Nominal voltage ($n \times 2.0V$)
- c) Rated capacity (C_{20} , see 5.1)
- d) Supplier's name and/or trade mark
- e) Year and month of manufacture or their abbreviation

If the values of functional characteristics or specific requirements are different from the values specified in 5, these values shall be supplied with the battery.

Additional data such as recommended charging voltage U_c or charging current I_c , capacity at other discharge rates, battery mass, etc. shall be supplied with the battery in a suitable way.

4.4 Marking of Polarity

To comply with the Standard, part 1, the battery shall carry a marking of polarity of both terminals by the plus symbol (+) and the minus symbol (−) on the lid adjacent to the terminals (see Graphical Symbol 5005 and 5006 of IEC 60417).

5. Functional Characteristics and Specific Requirements

5.1 Capacity

The essential characteristic of a battery is its capacity for the storage of electric energy. This capacity, expressed in ampere-hours (Ah), varies with the conditions of use (discharge-current, final voltage, temperature).

The rated capacity C_{20} is a reference value, to be declared by the manufacturer, which is valid for the discharge of a new battery at the discharge current stated in formula (1). The final voltage U_f shall be $n \times 1.75V$.

$$I_{20} = \frac{C_{20}}{20} \dots\dots\dots (1)$$

where, I_{20} : 20 hour-rate discharge current (A)

C_{20} : 20 hour-rate capacity (Ah)

The rated capacity C_1 is a reference value, to be declared by the manufacturer which is valid for the discharge of a new battery at the discharge current stated in formula (2). The final voltage U_f shall be $n \times 1.6V$.

$$I_1 = \frac{C_1}{1} \dots\dots\dots (2)$$

where, I_1 : 1 hour-rate discharge current (A)

C_1 : 1 hour-rate capacity (Ah)

The actual capacity C_a shall be determined by discharging a fully charged battery (see 6.1) with constant current I_{20} in accordance with 7.1. The actual capacity C_a measured in accordance with 7.1 may also be used for comparison with performance data (e.g. C_1) indicated by the manufacturer. In the above case the current I_{20} shall be replaced by a specific current corresponding to the related performance datum (e.g. I_1).

- a) The C_1 shall not be less than C_{20} within 5 cycles of charging and discharging.
- b) When the discharge is carried out at discharge current I_1 , C_{a1} shall not be less than C_1 .

5.2 High Rate Discharge Characteristics

When the discharge is carried out at a discharge current of $20 \times I_{20}$, the discharge duration shall be 27 minutes or more.

5.3 Endurance in Cycles

When a battery is tested in accordance with 7.3, the number of cycles shall be not less than 200.

5.4 Charge Retention

When a battery is tested in accordance with 7.4, the retained capacity shall be not less than 75% of C_a .

5.5 Maximum Permissible Current

Unless otherwise specified by the manufacturer, batteries shall show no distortion or other damage when discharged at a current shown in formula (3) for 300s and at a current shown in formula (4) for 5s (see 7.5).

$$I_m = 40 \times I_{20} \dots\dots\dots (3)$$

$$I_h = 300 \times I_{20} \dots\dots\dots (4)$$

where, I_m : 300-second permissible current (A)

I_h : 5-second permissible current (A)

I_{20} : 20-h discharge-rate current (A)

5.6 Charge Acceptance after Deep Discharge

When a battery is tested in accordance with 7.6, The capacity shall be not less than 75% of C_{20} .

5.7 Endurance in Trickle Service

When a battery is tested in accordance with 7.7, the years lapsed until the instant at which the capacity decreases below the specified capacity shall be two or more years.

5.8 Gas Recombinating Characteristics

- a) When the test specified in 7.8 a) is carried out, the gas recombining efficiency shall be 90% or more.
- b) When the test specified in 7.8 b) is carried out, the operating pressure of the vent valve shall be 0.98kPa to 196.1kPa.
- c) When the test specified in 7.8 c) is carried out, the battery shall be free from electrolyte leakage and other abnormalities.

5.9 Resistance to Vibration

When a battery is tested in accordance with 7.9, the battery shall be free from such abnormalities as remarkable deformation, damage and electrolyte leakage, and the terminal voltage shall be the nominal voltage or more.

5.10 Resistance to Shock

When a battery is tested in accordance with 7.10, the battery shall be free from such abnormalities as remarkable deformation, damage and electrolyte leakage, and the terminal voltage shall be the nominal voltage or more.

Informative reference **Overcharge Characteristics** When a battery is tested in accordance with Informative reference of 7, the battery shall show no abnormality on appearance and the capacity shall be 95% of C_{20} or more.

6. General Test Conditions

6.1 Sampling and Preparation of Batteries for Testing

All tests shall be carried out on new and fully charged samples, except when the tests are used for redetermination of the actual capacity to assess degradation after long periods of service.

Samples shall be considered as new not later than six months after the date of manufacture.

Batteries are considered as fully charged for test purpose of this Standard when tested according to the following procedures.

a) When Charged at Constant Voltage

Unless there is the constant voltage recommended by the manufacturer, batteries shall be charged at an ambient temperature of $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, at the constant voltage