



ANSI C18.1M, Part 2-2019

*American National Standard for
Portable Primary Cells and Batteries with
Aqueous Electrolyte—Safety Standard*

Secretariat:

National Electrical Manufacturers Association

Approved: May 10, 2019

American National Standards Institute

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Foreword (This foreword is not part of American National Standard ANSI C18.1M, Part 2-2019)

In 1912, a committee of the American Electrochemical Society recommended standard methods to be used in testing dry cells. Their recommendations were followed five years later when the National Bureau of Standards (currently the National Institute of Standards and Testing) prepared specifications that included cell sizes, the arrangement of cells within batteries, service tests, and required performance.

The need for continued revision to the specification led to the authorization, by the American Engineering Standards Committee, of a permanent sectional committee on dry cells. This committee, C18, representing battery users, manufacturers, and government agencies, has remained active since that time. Committee C18 prepared ANSI Standard C18.1M, Part 2, upon which this document is originally based under the sponsorship of the National Electrical Manufacturers Association (NEMA).

ANSI Standard C18.1M, Part 2, was created in parallel with the International Electrotechnical Commission (IEC) project to develop a product safety Standard for primary batteries with aqueous electrolyte (IEC Publication 60086-5). This revision was undertaken to provide a new over-discharge test for the 13-25 batteries and revise the criteria in select tests.

Suggestions for the improvement of this Standard are welcome. They should be sent to the National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 900, Rosslyn, VA 22209, Attention: Secretary ANSI ASC C18.

This Standard was processed and approved for submittal to ANSI by the Accredited Standards Committee C18 on Portable Cells and Batteries. Committee approval of the Standard does not necessarily imply that all committee Members voted for its approval. At the time it approved this Standard, the C18 committee had the following Members:

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This is a preview of "ANSI C18.1M Part 2-2...". [Click here to purchase the full version from the ANSI store.](#)

1 Introduction

The concept of safety is closely related to safeguarding the integrity of people and property. This Standard defines performance requirements for primary batteries with aqueous electrolyte to ensure their safe operation under normal use and reasonably foreseeable misuse.

Safety is a balance between freedom from risk of harm and other demands to be met by the product. There can be no absolute safety. Even at the highest level of safety, the product can only be relatively safe. In this respect, decision-making is based on risk evaluation and safety judgment.

As safety will pose different problems, it is impossible to provide a set of precise provisions and recommendations that will apply in every case. This may be particularly true for button-type batteries. However, when following a judicious "use when applicable" basis this Standards publication will provide reasonably consistent standards for safety.

2 Scope

This American National Standard specifies tests and requirements for portable primary batteries with aqueous electrolyte and zinc anode (non-lithium) to ensure their safe operation under normal use and reasonably foreseeable misuse. For reference, the chemical systems standardized in ANSI C18.1M, Part 1 are:

- a. Carbon Zinc (Leclanché and Zinc Chloride types);
- b. Alkaline Manganese Dioxide;
- c. Silver Oxide;
- d. Zinc air;
- e. Nickel Oxy-Hydroxide.

3 Normative References

The following Standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All Standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent editions of the Standards indicated below.

ANSI C18.1M, Part 1, *American National Standard for Portable Primary Cells and Batteries with Aqueous Electrolyte—General and Specifications*

4 Definitions

For the purposes of this American National Standard, the following definitions apply:

battery: One or more cells, including case, terminals, and marking.

battery, button: Small round battery, where the overall height is less than the diameter.

battery or cell, cylindrical: A round cell or battery in which the overall height is equal to or greater than the diameter.

battery, portable: A battery that is easily hand-carried.

battery, prismatic: A battery with non-round geometry.

cell, primary: A source of electrical energy obtained by the direct conversion of chemical energy that is not designed to be charged by any other electrical source.

fire: Combustion of cell/battery components with the emission of flame.

harm: Physical injury and/or damage to health or property.

hazard: A potential source of harm.

intended use: The use of a product, process, or service in accordance with specifications, information, and instructions provided by the supplier.

leakage: The unplanned escape of electrolyte from a cell or battery.

nominal voltage: Suitable approximate value used to designate or identify the voltage of a cell, battery, or electrochemical system.

polarity: The electrical convention used to describe the direction in which current flows on discharge.

reasonably foreseeable misuse: The use of a product, process, or service under conditions or for purposes not intended by the supplier, but which may happen as a result of common human behavior.

risk: The probable rate of occurrence of a hazard causing harm and the degree of severity.

rupture: A rupture is considered to have occurred if, during a test, a cell container or battery case has mechanically failed, resulting in the expulsion of gas, spillage of liquids, or ejection of solid materials.

safety: Freedom from unacceptable risk of harm.

small cell or battery: A cell or battery fitting entirely within the limits of the ingestion gauge as defined in Figure 1.

venting: The release of excessive internal pressure from a cell or battery in a manner intended by design to preclude rupture.

voltage, closed-circuit (CCV): The voltage of a battery when an external current is flowing.

voltage, open circuit (OCV): The voltage of a battery when no external current is flowing.

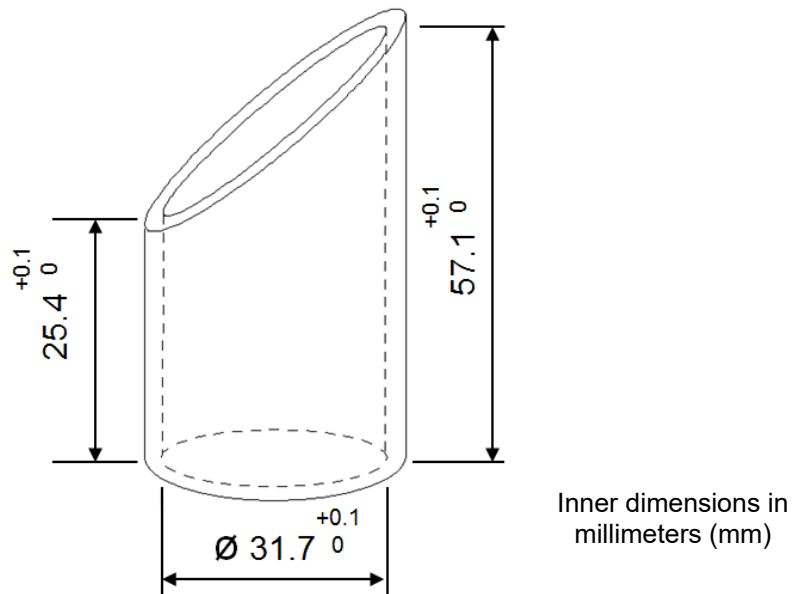


Figure 1
Ingestion Gauge

5 Requirements for Safety

5.1 Design

5.1.1 General

Batteries shall be so designed that they do not present a safety hazard under conditions of normal (intended) use. Compliance can be determined by testing specified in Tables 5, 6, and 7. When discharged on an application test in accordance with ANSI C18.1M, Part 1, there shall be no evidence of leakage, venting, fire, or rupture.

Compliance is verified by performing the tests required in this document and by meeting the stated acceptance requirements.

5.1.2 Battery Case

The casing of a battery shall be of a material and form that satisfies the mold stress test given in 7.5.2.

5.1.3 Venting

All cells shall incorporate a pressure relief mechanism or shall be so constructed that they will relieve excessive internal pressure at a value and rate that will preclude rupture or self-ignition. If encapsulation is necessary to support cells within an outer case, the type of encapsulant and the method of encapsulation should not cause the battery to overheat during normal operation nor inhibit pressure relief.

The battery case material and/or its final assembly should 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.

5.1.4 Temperature/Current Management

The design of large cylindrical and prismatic batteries shall be such that:

- a. Abnormal temperature rise due to external conditions is prevented through the use of thermal limitation features that are an integral part of the battery and may allow re-use of the battery if the feature is resettable;
- b. Rapid internal temperature rise conditions shall be controlled by the immediate and irreversible shut down of the battery, thus precluding further use.

5.1.5 Multi-Cell Molded Plastic Battery Enclosure

For multi-cell batteries with plastic over-cases, the over-case should be so designed such that it cannot be opened without mechanical assistance.


5.1.6 Quality Assurance Plan

The manufacturer should prepare and implement a quality plan that defines procedures for the inspection of materials, components, cells, and batteries and which covers the whole process of producing each type of cell or battery. Manufacturers should understand their process capabilities and should institute the necessary process controls as they relate to product safety.

6 Sampling for Type Approval

See Table C.1 in Annex C for the minimum requirements for sample sizes.

7 Testing and Compliance (Verification)

	<p>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 appropriately qualified and experienced technicians will conduct them using adequate protection.</p>
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Tables 1, 2, 3, 4, and 5 at the end of this section summarize the required tests.

7.1 General

7.1.1 Test Temperature

All tests shall be conducted at a test temperature of $20 \pm 5^{\circ}\text{C}$ unless otherwise specified.

7.2 Pretest Dimensions, Voltage, and Insulation Resistance Test Requirements

Samples selected for pretest shall meet the requirements specified for dimensions, open-circuit voltage, closed-circuit voltage, and insulation resistance. Samples failing to meet these requirements shall be discarded. New sample batteries that meet the pretest requirements shall be selected.

7.2.1 Dimensions

The dimensions shall meet the dimensions specified in the relevant specification sheet in ANSI C18.1M, Part 1.

7.2.2 Open Circuit Voltage

The open-circuit voltage shall meet the requirements on the relevant specification sheet in ANSI C18.1M, Part 1.

7.2.3 Closed Circuit Voltage

The initial closed-circuit voltage (within 5 seconds) of the sample battery shall be checked under a rating or application test specified in the relevant specification sheet in ANSI C18.1M, Part 1. This voltage shall be within 5 percent of the typical initial closed-circuit voltage for that battery.

7.2.4 Insulation Resistance Test

Purpose

To measure the insulation resistance when applicable between externally exposed surfaces of the battery and the positive terminal, excluding measurement between the positive and negative terminals.