



ANSI/NEMA C18.1M, Part 2-2017

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



National Electrical Manufacturers Association
1300 North 17th Street, Suite 900 • Rosslyn, VA 22209
www.NEMA.org

Currently in preview, click buy full version





ANSI C18.1M, Part 2-2017

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

Secretariat:

National Electrical Manufacturers Association

Approved March 28, 2017

American National Standards Institute

NOTICE AND DISCLAIMER

The information in this publication was considered technically sound by the consensus of persons engaged in the development and approval of the document at the time it was developed. Consensus does not necessarily mean that there is unanimous agreement among every person participating in the development of this document.

ANSI standards and guideline publications, of which the document contained herein is one, are developed through a voluntary consensus standards development process. This process brings together volunteers and/or seeks out the views of persons who have an interest in the topic covered by this publication. While NEMA administers the process to promote fairness in the development of consensus, it does not write the document, and it does not independently test, evaluate, or verify the accuracy or completeness of any information or the soundness of any judgments contained in its standards and guideline publications.

NEMA disclaims liability for any personal injury, property, or other damages of any nature whatsoever, whether special, indirect, consequential, or compensatory, directly or indirectly resulting from the publication, use of, application, or reliance on this document. NEMA disclaims and makes no guaranty or warranty, expressed or implied, as to the accuracy or completeness of any information published herein, and disclaims and makes no warranty that the information in this document will fulfill any of your particular purposes or needs. NEMA does not undertake to guarantee the performance of any individual manufacturer or seller's products or services by virtue of this standard or guide.

In publishing and making this document available, NEMA is not undertaking to render professional or other services for or on behalf of any person or entity, nor is NEMA undertaking to perform any duty owed by any person or entity to someone else. Anyone using this document should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances. Information and other standards on the topic covered by this publication may be available from other sources, which the user may wish to consult for additional views or information not covered by this publication.

NEMA has no power, nor does it undertake, to police or enforce compliance with the contents of this document. NEMA does not certify, test or inspect products, designs, or installations for safety or health purposes. Any certification or other statement of compliance with any health- or safety-related information in this document shall not be attributable to NEMA and is solely the responsibility of the certifier or maker of the statement.

AMERICAN NATIONAL STANDARD

Approval of an American National Standard requires verification by The American National Standards Institute, Inc. (ANSI) that the requirements for due process, consensus, and other criteria for approval have been met by the standards developer. An American National Standard implies a consensus of those substantially concerned with its scope and provisions. Consensus is established when, in the judgment of the ANSI Board of Standards Review, substantial agreement has been reached by directly, and materially affected interests. Substantial agreement means much more than a simple majority, but not necessarily unanimity. Consensus requires that all views and objections be considered and that a concerted effort be made toward their resolution.

The existence of an American National Standard does not in any respect preclude anyone, whether s/he has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standards. It is intended as a guide to aid the manufacturer, the consumer, and the general public.

The American National Standards Institute, Inc., does not develop standards and will in no circumstances give an interpretation of any American National Standard. Moreover, no person shall have the right or authority to issue an interpretation of an American National Standard in the name of the American National Standards Institute, Inc. Requests for interpretations should be addressed to the secretariat or sponsor whose name appears on this title page.

CAUTION NOTICE: This American National Standard may be revised or withdrawn at any time. The procedures of the American National Standards Institute, Inc. require that action be taken periodically to reaffirm, revise, or withdraw this standard. Purchasers of American National Standards should receive current information on all standards by calling or writing the American National Standards Institute, Inc.

Published by

National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

© 2017 National Electrical Manufacturers Association

All rights, including translation into other languages, reserved under the Universal Copyright Convention, the Bern Convention for the Protection of Literary and Artistic Works, and the International and Pan American copyright conventions.

No part of this publication may be reproduced in any form, in an electronic retrieval system or otherwise, without the prior written permission of the publisher.

Printed in the United States of America

< This page intentionally left blank >

Currently in preview, click buy full version

CONTENTS

Foreword	v
1 Introduction	1
2 Scope	1
3 Normative References	1
4 Definitions	1
5 Requirements for Safety	3
5.1 Design	3
5.1.1 General	3
5.1.2 Battery Case	3
5.1.3 Venting	3
5.1.4 Temperature/Current management	4
5.1.5 Multi-Cell Molded Plastic Battery Enclosure	4
5.1.6 Quality Assurance Plan	4
6 Sampling for Type Approval	5
7 Testing and Compliance (Verification)	5
7.1 General	5
7.1.1 Test Temperature	5
7.2 Pretest Dimensions, Voltage, and Insulation Resistance Test Requirements	5
7.2.1 Dimensions	5
7.2.2 Open Circuit Voltage	5
7.2.3 Closed Circuit Voltage	5
7.2.4 Insulation Resistance Test	5
7.3 Intended Use Simulation Tests	6
7.3.1 Test A: Partial Use	6
7.3.2 Test B: Vibration	7
7.3.3 Test C: Thermal Shock	8
7.3.4 Test D: Mechanical Shock	8
7.4 Reasonably Foreseeable Misuse Tests	9
7.4.1 Test E: Incorrect Installation	9
7.4.2 Test F: External Short Circuit	10
7.4.3 Test G: Free Fall (User Drop)	11
7.4.4 Test H: Over Discharge	12
7.4.5 Test I: Crush	13
7.5 Design Consideration Tests	14
7.5.1 Test J: Thermal Abuse	14
7.5.2 Test K: Mold Stress	14
8 Information for Safety	18
9 Instructions for Use	19
10 Marking	19
10.1 General	19
10.2 Small Size Batteries	19
Annex A Guidance for Device Designers	20

Annex B Guidance for Packaging, Handling, and Transportation.....	27
Annex C Compliance checklist.....	29
Annex D Maximum temperature during usage	30
Annex E Bibliography.....	31

TABLES

Table 1 Vibration Test Sequence.....	7
Table 2 Shock Pulse	9
Table 3 Tests Required for Single Cell Batteries.....	16
Table 4 Test References.....	16
Table 5 Tests Required for Multi-Cell Batteries	17
Table A.1 Suggested Minimum Diameters for Coil Spring Wire	26
Table C.1 Compliance Checklist.....	29
Table D.1 Recommended maximum temperatures	30

FIGURES

Figure 1 Ingestion Gauge.....	3
Figure 2 Circuit Diagram for Test E: Incorrect Installation	10
Figure 3 Circuit Diagram for Test F: External Short Circuit	11
Figure 4 Circuit Diagram for Test H: Over-Discharge.....	12
Figure 5 Example of Series Connection with One Battery Reversed	20
Figure 6 Positive Contact, Contact Recessed Between Ribs	22
Figure 7 Positive Contact, Recessed Aperture.....	22
Figure 8 Negative Contact, Contact is “U” Shaped.....	23
Figure 9 Battery Orientation Examples	24
Figure 10A Example of a Short Circuit—A Switch is Piercing the Battery Insulating Jacket.....	24
Figure 10B Example of Insulation to Prevent Short Circuit—Insulating Material Positioned as Shown Prevents the Switch from Damaging the Battery Jacket.....	25
Figure 11 Examples Showing Distorted Springs.....	25
Figure 12 One Example of Protected Insertion Design	26

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

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, 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 update the safety tests and content in ANSI Standard C18.1M, Part 2 and to keep them current with the best possible practices.

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:

Steven Wicelinski, Chairperson
Marcus Boolish, Vice-chairperson
Khaled Masri, Secretary

Name of Representative:		Organization Represented:
Heather	Peterson	Batteries Plus Bulbs
David	Grandin	Bureau Veritas Consumer Product Services
S. Keel	Kelly	Consultant
Robert	Coughlin	Consumer Product Integrity Consulting, LLC
Steven	Wicelinski	Duracell, Inc.
Marcus	Boolish	Energizer Brands, LLC
Carin	Stuart	Energizer Brands, LLC (Alt.)
Donna	Golde	Fisher-Price
Thomas	O'Hara	Intertek
Michal	Byczek	Intertek (Alt.)
Charles	Monahan	Panasonic Corporation of North America
Jody	Leber	SGS North America
John	Hadley	Spectrum Brands, Inc.
Denis	Carpenter	Spectrum Brands, Inc. (Alt.)

Andy	Roszkowski	Spectrum Brands, Inc. (Alt.)
Laurie	Florence	UL LLC
Jeff	Ortega	ZPower, LLC
Tim	Powers	ZPower, LLC (Alt.)

The members of Subcommittee C18-5 on Safety Standards who contributed to the development of this standard are:

Carin Stuart, Chairperson
Tom O'Hara, Vice-chairperson
Khaled Masri, Secretary

Jeff	Becker
Marcus	Booish
Rich	Byczek
Denis	Carpenter
Robert	Coughlin
Laurie	Florence
Douglas	Golde
David	Grandin
John	Hadley
Ray	Iveson
S. Keel	Kelly
Jody	Leber
Charles	Monahan
Thomas	O'Hara
Jeff	Ortega
Tim	Powers
Andy	Roszkowski
John	Rotondo
Carin	Stuart
Steven	Wicelinski

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, this standard, when followed on a judicious “use when applicable” basis, 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, cylindrical: A battery, with cylindrical geometry, where 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.