IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

Amendment 1: Updated VRLA Maintenance Considerations

**IEEE Power and Energy Society** 

Sponsored by the Stationary Batteries Committee

IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications

# Amendment 1: Updated VRLA Maintenance Considerations

Sponsor

Stationary Batteries Committee of the IEEE Power and Energy Society

Approved 16 May 2014

**IEEE-SA Standards Board** 

**Abstract:** New guidance to users dealing with premature capacity failures with VRLA batteries and updated definitions are addressed in this amendment.

**Keywords:** battery capacity test, IEEE 1188a<sup>™</sup>, premature capacity loss, special recovery process, valve-regulated lead-acid (VRLA) battery

The Institute of Electrical and Electronics Engineers, Inc. 3 Park Avenue, New York, NY 10016-5997, USA

Copyright © 2014 by The Institute of Electrical and Electronics Engineers, Inc. All rights reserved. Published 11 July 2014. Printed in the United States of America.

IEEE is a registered trademark in the U.S. Patent & Trademark Office, owned by The Institute of Electrical and Electronics Engineers, Incorporated.

PDF: ISBN 978-0-7381-9224-6 STD98726 Print: ISBN 978-0-7381-9225-3 STDPD98726

## Important Notices and Disclaimers Concerning IEEE Standards Documents

IEEE documents are made available for use subject to important notices and legal disclaimers. These notices and disclaimers, or a reference to this page, appear in all standards and may be found under the heading "Important Notice" or "Important Notices and Disclaimers Concerning IEEE Standards Documents."

# Notice and Disclaimer of Liability Concerning the Use of IEEE Standards Documents

IEEE Standards documents (standards, recommended practices, and guides), both full-use and trial-use, are developed within IEEE Societies and the Standards Coordinating Committees of the IEEE Standards Association ("IEEE-SA") Standards Board. IEEE ("the Institute") develops its standards through a consensus development process, approved by the American National Standards Institute ("ANSI"), which brings together volunteers representing varied viewpoints and interests to achieve the final product. Volunteers are not necessarily members of the Institute and participate without compensation from IEEE. While IEEE administers the process and establishes rules to promote fairness in the consensus development process, IEEE does not independently evaluate, test, or verify the accuracy of any of the information or the soundness of any judgments contained in its standards.

IEEE does not warrant or represent the accuracy or content of the material contained in its standards, and expressly disclaims all warranties (express, implied and statutory) not included in this or any other document relating to the standard, including, but not limited to, the warranties of: merchantability; fitness for a particular purpose; non-infringement; and quality, accuracy, effectiveness, currency, or completeness of material. In addition, IEEE disclaims any and all conditions relating to: results; and workmanlike effort. IEEE standards documents are supplied "AS IS" and "WITH ALL FAULTS."

Use of an IEEE standard is wholly voluntary. The existence of an IEEE standard does not imply that there are no other ways to produce, test, measure, purchase, market, or provide other goods and services related to the scope of the IEEE standard. Furthermore, the viewpoint expressed at the time a standard is approved and issued is subject to change brought about through developments in the state of the art and comments received from users of the standard.

In publishing and making its standards available, IEEE is not suggesting or rendering professional or other services for, or on behalf of, any person or entity nor is IEEE undertaking to perform any duty owed by any other person or entity to another. Any person utilizing any IEEE Standards document, should rely upon his or her own independent judgment in the exercise of reasonable care in any given circumstances or, as appropriate, seek the advice of a competent professional in determining the appropriateness of a given IEEE standard.

IN NO EVENT SHALL IEEE BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO: PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE PUBLICATION, USE OF, OR RELIANCE UPON ANY STANDARD, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE AND REGARDLESS OF WHETHER SUCH DAMAGE WAS FORESEEABLE.

#### **Translations**

The IEEE consensus development process involves the review of documents in English only. In the event that an IEEE standard is translated, only the English version published by IEEE should be considered the approved IEEE standard.

#### Official statements

A statement, written or oral, that is not processed in accordance with the IEEE-SA Standards Board Operations Manual shall not be considered or inferred to be the official position of IEEE or any of its committees and shall not be considered to be, or be relied upon as, a formal position of IEEE. At lectures, symposia, seminars, or educational courses, an individual presenting information on IEEE standards shall make it clear that his or her views should be considered the personal views of that individual rather than the formal position of IEEE.

#### Comments on standards

Comments for revision of IEEE Standards documents are welcome from any interested party, regardless of membership affiliation with IEEE. However, IEEE does not provide consulting information or advice pertaining to IEEE Standards documents. Suggestions for changes in documents should be in the form of a proposed change of text, together with appropriate supporting comments. Since IEEE standards represent a consensus of concerned interests, it is important that any responses to comments and questions also receive the concurrence of a balance of interests. For this reason, IEEE and the members of its societies and Standards Coordinating Committees are not able to provide an instant response to comments or questions except in those cases where the matter has previously been addressed. For the same reason, IEEE does not respond to interpretation requests. Any person who would like to participate in revisions to an IEEE standard is welcome to join the relevant IEEE working group.

Comments on standards should be submitted to the following address:

Secretary, IEEE-SA Standards Board 445 Hoes Lane Piscataway, NJ 08854 USA

## Laws and regulations

Users of IEEE Standards documents should consult all applicable laws and regulations. Compliance with the provisions of any IEEE Standards document does not imply compliance to any applicable regulatory requirements. Implementers of the standard are responsible for observing or referring to the applicable regulatory requirements. IEEE does not, by the publication of its standards, intend to urge action that is not in compliance with applicable laws, and these documents may not be construed as doing so.

## Copyrights

IEEE draft and approved standards are copyrighted by IEEE under U.S. and international copyright laws. They are made available by IEEE and are adopted for a wide variety of both public and private uses. These include both use, by reference, in laws and regulations, and use in private self-regulation, standardization, and the promotion of engineering practices and methods. By making these documents available for use and adoption by public authorities and private users, IEEE does not waive any rights in copyright to the documents.

#### **Photocopies**

Subject to payment of the appropriate fee, IEEE will grant users a limited, non-exclusive license to photocopy portions of any individual standard for company or organizational internal use or individual, non-commercial use only. To arrange for payment of licensing fees, please contact Copyright Clearance Center, Customer Service, 222 Rosewood Drive, Danvers, MA 01923 USA; +1 978 750 8400. Permission to photocopy portions of any individual standard for educational classroom use can also be obtained through the Copyright Clearance Center.

## **Updating of IEEE Standards documents**

Users of IEEE Standards documents should be aware that these documents may be superseded at any time by the issuance of new editions or may be amended from time to time through the issuance of amendments, corrigenda, or errata. An official IEEE document at any point in time consists of the current edition of the document together with any amendments, corrigenda, or errata then in effect.

Every IEEE standard is subjected to review at least every ten years. When a document is more than ten years old and has not undergone a revision process, it is reasonable to conclude that its contents, although still of some value, do not wholly reflect the present state of the art. Users are cautioned to check to determine that they have the latest edition of any IEEE standard.

In order to determine whether a given document is the current edition and whether it has been amended through the issuance of amendments, corrigenda, or errata, visit the IEEE-SA Website at <a href="http://ieeexplore.ieee.org/xpl/standards.jsp">http://ieeexplore.ieee.org/xpl/standards.jsp</a> or contact IEEE at the address listed previously. For more information about the IEEE-SA or IEEE's standards development process, visit the IEEE-SA Website at <a href="http://standards.ieee.org">http://standards.ieee.org</a>.

#### Errata

Errata, if any, for all IEEE standards can be accessed on the IEEE-SA Website at the following URL: <a href="http://standards.ieee.org/findstds/errata/index.html">http://standards.ieee.org/findstds/errata/index.html</a>. Users are encouraged to check this URL for errata periodically.

#### **Patents**

Attention is called to the possibility that implementation of this standard may require use of subject matter covered by patent rights. By publication of this standard, no position is taken by the IEEE with respect to the existence or validity of any patent rights in connection therewith. If a patent holder or patent applicant has filed a statement of assurance via an Accepted Letter of Assurance, then the statement is listed on the IEEE-SA Website at <a href="http://standards.ieee.org/about/sasb/patcom/patents.html">http://standards.ieee.org/about/sasb/patcom/patents.html</a>. Letters of Assurance may indicate whether the Submitter is willing or unwilling to grant licenses under patent rights without compensation or under reasonable rates, with reasonable terms and conditions that are demonstrably free of any unfair discrimination to applicants desiring to obtain such licenses.

Essential Patent Claims may exist for which a Letter of Assurance has not been received. The IEEE is not responsible for identifying Essential Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims, or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of this standard are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information may be obtained from the IEEE Standards Association.

# **Participants**

Robert Fletcher

At the time this IEEE amendment was completed, the VRLA Maintenance and Testing Working Group had the following membership:

William Cantor, Chair John Byrne, Vice Chair Curtis Ashton, Secretary

William Ackerman Kyle Floyd Samuel Aguirre Rabiz Foda Edward Amato Rvan Frank Curtis Ashton John Gagge Jr. Adam Bagby Randall Groves Gary Balash Ajit Gwal Thomas Barnes Paul Anthonius Cornelis Hectors David Battle Scott Hietpas David Ittner Robert Beavers Chistopher Belcher Randy Jamison Alan Jensen Steven Bezner William Bloethe Wayne Johnson Jeff Bruce James Kinney Paul Cardinal Jim Kulchisky Michael Carmel Thomas Ladson Thomas Carpenter Gael Kennedy Larry Carson Chung-Yiu Lam Leonard Casella Jeffrey LaMarca Brian Casey Daniel Lambert Yves Lavoie Jeremiah Causby Terry Chapman Michael May Troy Chatwin John Mcalhaney Jr. Stephen Mccluer Mark Clark Garth Corey William Mccoy Charles Cotton James Mcdowall Larry Meisner Jesus DeLeon Diaz Peter Demar James Midolo Gary Donner Russell Miller Randall Dotson David T. Mills Sourav Dutta Daleep Mohla Charles Finin Kimberly Mosley

Michael Newman Joe Nims Michael Nispel Gary Nissen Rudy Ortega Bansi Patel Shawn Peng John Polenz **Edward Rafter** John Randolph Jan Reber Michael Roberts Charles Rogers **Edward Rogers** Bartien Savogo Robert Schuerger Christo Searles Robert Seitz Brandon Smith David Smith Gary Stoedter Malcolm Thaden Richard Tressler Eric Udren Lesley Varga Stephen Vechy John Vergis Kenneth White Jian Yu James Ziebarth

Haissam Nasrat

Dennis Neitzel

The following members of the individual balloting committee voted on this amendment. Balloters may have voted for approval, disapproval, or abstention.

William Ackerman Randall Groves Dennis Neitzel Samuel Aguirre Ajit Gwal Michael Newman Edward Amato Paul Anthonius Cornelis Hectors Joe Nims Curtis Ashton Scott Hietpas Gary Nissen Gary Balash David Ittner Bansi Patel Thomas Barnes Alan Jensen John Polenz Robert Beavers Gael Kennedy Jan Reber Steven Bezner James Kinney Michael Roberts Jim Kulchisky William Bloethe Charles Rogers William Cantor Thomas Ladson Bartien Sayogo Chung-Yiu Lam Robert Schuerger Paul Cardinal Christo Searles Thomas Carpenter Jeffrey LaMarca Larry Carson Daniel Lambert Robert Seitz Mark Clark Daniel Levin David Smith Garth Corey Greg Luri Gary Stoedter Charles Cotton Jose Marrero Malcolm Thaden Peter Demar Michael May Richard Tressler Gary Donner John Mcalhanev Jr Eric Udren Randall Dotson Stephen Mccluer Lesley Varga Sourav Dutta William Mccoy John Vergis Charles Finin James Mcdowall Kenneth White Robert Fletcher Daleep Mohla Jian Yu John Gagge Jr. Kimberly Mosley James Ziebarth Haissam Nasrat

When the IEEE-SA Standards Board approved this amendment on 16 May 2014, it had the following membership:

John Kulick, Chair Jon Walter Rosdahl, Vice Chair Richard H. Hewlett, Past Chair Konstantinos Karachalios, Secretary

Peter Balma Michael Janezic Ron Peterson Farooq Bari Jeffrey Katz Adrian Stephens Ted Burse Joseph L. Koepfinger\* Peter Sutherland Clint Chaplain David Law Yatin Trivedi Phil Winston Stephen Dukes Hung Ling Jean-Phillippe Faure Oleg Logvinov Don Wright Gary Hoffman Ted Olsen Yu Yuan Glenn Parsons

Also included are the following nonvoting IEEE-SA Standards Board liaisons:

Richard DeBlasio, *DOE Representative* Michael Janezic, *NIST Representative* 

> Michelle Turner IEEE-SA Content Publishing

Malia Zaman
IEEE-SA Standards Technical Community

<sup>\*</sup>Member Emeritus

# Introduction

This introduction is not part of IEEE Std 1188a<sup>TM</sup>-2014, IEEE Recommended Practice for Maintenance, Testing, and Replacement of Valve-Regulated Lead-Acid (VRLA) Batteries for Stationary Applications—Amendment 1: Updated VRLA Maintenance Considerations.

New guidance to users dealing with premature capacity failures with VRLA batteries and updated definitions are addressed in this amendment.

# Contents

2. Normative references	2
3. Definitions	2
5. Maintenance	3
7. Procedure for battery tests 7.3 Test length and discharge rate 7.4 Capacity test methods	3
8. Battery replacement criteria	4
Annex C (informative) Corrective actions  C.3 Equalizing charge  C.6 Float current	5
Annex E (informative) Calculation of battery capacity  E.3 Capacity calculation examples	
Annex G (informative) Glossary	10