



Approved as an American National Standard
ANSI Approval Date: August 6, 2021
Previously: NEMA ESM1-2 2019

ANSI/NEMA SM 31000-2-2021

Electrical Submeter—Active Energy Accuracy

Published by:

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

www.nema.org

© 2021 National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

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.

The National Electrical Manufacturers Association (NEMA) 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 and establishes rules 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.

Foreword

In the preparation of this Standards publication, input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product subdivision by contacting the:

NEMA Technical Operations Department
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

This Standard was originally developed by the NEMA BS-SM ESM1 Working Group and published under the NEMA ESM1-2 2019 designation. In its current form, it was approved by the ANSI ESM1 Consensus Group under the ANSI/NEMA ESM1-2 designation. NEMA has changed its designation policy in 2021 and subsequently changed the designation of the entire SM 31000 Standards series to SM 31000.

Main contributors were:

Daniel	Aljadeff	Panoramic Power / Centrica
Henry	Alton	Metergy Solutions Inc. Triacta Power Solutions Division
Dave	Bovankovich	Quadlogic Controls Corporation
Nathaniel	Crutcher	Continental Control Systems, LLC
Craig	Denson	DENT Instruments, Inc.
Don	McComas	Eaton
Tom	Nelson	NIST
Aaron	Parker	Schneider Electric

Contents

Foreword.....	i
1 General	1
1.1 Scope.....	1
1.2 Definitions.....	1
1.3 Normative References.....	1
1.4 Bibliography.....	1
2 Performance Requirements and Test Procedures.....	2
2.1 Testing Overview.....	2
2.1.1 Accuracy Test Sequence	2
2.1.2 Meter Element Reporting	2
2.1.3 Test Voltage	2
2.1.4 Test Loading.....	3
2.1.5 Expanded Load Range and Multiple Sensor Testing.....	3
2.2 Accuracy Tests	4
2.2.1 Test Summary	4
2.2.2 Minimum Test Energy.....	6
2.2.3 No Load Test.....	7
2.2.4 Starting Load Test.....	7
2.2.5 Load Variation Tests.....	8
2.2.6 Frequency Variation Tests	8
2.2.7 Voltage Variation Tests	8
2.3 Equality of Meter Elements Tests.....	8
2.4 Electromagnetic Compatibility (EMC) Tests.....	9
2.4.1 No Applied Load EMC Tests	9
2.4.2 Power Frequency Magnetic Field Immunity Test	9
2.5 Alternate Current Sensor Tests.....	10
2.5.1 Current Sensor Design Type EMC Immunity Tests	10
2.5.2 Active Current Sensor Design Type EMC Immunity Tests	10
2.6 Alternate Voltage Sensor Tests.....	11
2.6.1 Voltage Sensor Design Type EMC Immunity Tests	11
2.7 Service Type Tests.....	12
2.8 Multiple Frequency Meter Tests.....	12
2.9 Bidirectional Meter Tests.....	12

Tables

Table 1 List of Accuracy Tests for $C \leq 1$	4
Table 2 List of Accuracy Tests for $C > 1$	6
Table 3 Current Sensor Design Type EMC Immunity Tests	10
Table 4 Active Current Sensor Design Type EMC Immunity Tests.....	11
Table 5 Design Type EMC Immunity Tests for Voltage Sensors	12

1 General

1.1 Scope

This Standard covers metrological requirements and associated testing for AC meters and meter systems rated at not more than 1,000 V that measure active energy used in electrical energy submetering applications.

1.2 Definitions

See **SM 31000-1 General Requirements** for common definitions.

1.3 Normative References

- a. ANSI/NEMA SM 31000-1 *Electrical Submeter—General Requirements*

1.4 Bibliography

The following publications provide background for this Standard. When they are superseded, the latest approved revision should be used.

- a. ANSI C12.1-2014 *American National Standard for Electricity Meters—Code for Electricity Metering*
- b. ANSI C12.20-2015 *American National Standard for Electricity Meters—0.1, 0.2, and 0.5 Accuracy Classes*
- c. IEC 62053-23:2020 *Electricity metering equipment - Particular requirements - Part 23: Static meters for reactive energy (classes 2 and 3)*
- d. BS 8431:2010 *Electrical static meters for secondary metering and sub-metering. Specification*
- e. IEEE Std 1459-2010 *IEEE Standard Definitions for the Measurement of Electric Power Quantities Under Sinusoidal, Nonsinusoidal, Balanced, or Unbalanced Conditions*