



**ANSI C82.6-2015 (R2020)**

*American National Standard for Lamp Ballasts—  
Ballasts for High-Intensity Discharge Lamps—  
Methods of Measurement*

Secretariat:

**National Electrical Manufacturers Association**

Approved: March 30, 2020

**American National Standards Institute, Inc.**

## 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.

American National Standards Institute, Inc. (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 Standards Institute, Inc. (ANSI) Standard requires verification by 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 Committee Secretariat referred to on the 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 may receive current information on all Standards by calling or writing the American National Standards Institute, Inc.

Published by

**National Electrical Manufacturers Association**  
**1300 North 17<sup>th</sup> Street, Suite 900**  
**Rosslyn, Virginia 22209**

© 2020 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.

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

Printed in the United States of America

## **Foreword**

This foreword is not part of American National Standard C82.6-2015 (R2020).

Suggestions for improvement of this Standard are welcomed. They should be sent to Secretariat C82 Committee, National Electrical Manufacturers Association, 1300 North 17<sup>th</sup> Street, Suite 900, Rosslyn, VA 22209.

This Standard was processed and approved for submittal to ANSI by the Accredited Standards Committee on Lamp Ballasts, C82. Approval of the Standard does not necessarily imply that all work group Members voted for its approval.

This Standard is a reaffirmation of ANSI C82.6-2015.

## CONTENTS

Foreword .....	ii
<b>1 Scope.....</b>	<b>1</b>
1.1 Patent Disclaimer .....	1
<b>2 Normative References .....</b>	<b>1</b>
<b>3 Definitions.....</b>	<b>1</b>
<b>4 General Conditions for Electrical Performance Tests .....</b>	<b>2</b>
4.1 Power Supply .....	2
4.2 Ballast Conditions .....	2
4.3 Lamp Position.....	2
4.4 Lamp Stabilization .....	2
4.4.1 Lamp Precondition .....	2
4.4.2 Basic Stabilization Method.....	2
4.4.3 Alternative Stabilization Method (Electronic Ballasts) .....	3
4.5 Instrumentation.....	3
4.5.1 Accuracy .....	3
4.5.2 Impedance Limitations .....	4
4.5.3 Connection of Analog Instruments in the Circuit .....	4
4.5.4 Root-Mean-Square (rms) Measurements .....	4
4.5.5 Peak Measurements .....	5
4.5.6 Current THD Measurement .....	5
4.5.7 Oscilloscope Requirements .....	5
4.5.8 Equipment to Measure Starting and Sustaining Parameters .....	5
<b>5 Reference-Ballast Circuits .....</b>	<b>6</b>
5.1 Reference-Ballast Characteristics.....	6
5.2 Adjustment and Test .....	6
5.3 Ballast and Instrument Connections .....	6
<b>6 Ballast Measurements (Multiple Supply-type Ballasts) .....</b>	<b>6</b>
6.1 Input Circuit Measurements .....	6
6.1.1 Starting Conditions.....	6
6.1.2 Operating Conditions .....	6
6.2 Output (Lamp) Circuit Measurements .....	6
6.2.1 Starting Conditions.....	6
6.2.2 Operating Conditions .....	7
6.2.3 Resistive Load (Electromagnetic Ballast Only).....	7
6.3 Circuit Connections .....	7
6.3.1 Circuit and Equipment Grounding.....	7

6.4	Measurement of Sustaining Parameters of Peak Lead High-Intensity Discharge Lamp Magnetic Ballasts .....	8
6.4.1	Current Slope and Off-time Measurements .....	8
6.4.2	Current Overshoot Measurement .....	8
6.4.3	Sustaining Voltage Measurements .....	8
6.4.4	Peak Current .....	9
6.5	Open Circuit Voltage .....	9
6.5.1	Electromagnetic Ballast .....	9
6.5.2	Electronic Ballast with Superimposed Ignition Open Circuit Voltage .....	9
6.5.3	Electronic Ballast Open Circuit Voltage—Non-Superimposed Resonant Ignition .....	11
6.6	Electronic Ballast—Pulse Burst Ignition Open Circuit Voltage—Non-Superimposed Ignition ....	11
6.7	Measurement of Starting Pulse and Pulse Burst Parameters .....	12
6.7.1	Ignitor Electrical Characteristics .....	12
6.8	Input Current and Power .....	13
6.8.1	Current .....	13
6.8.2	Current THD .....	14
6.8.3	Power .....	14
6.9	Electronic Ballast Starting and Run Up current .....	14
6.9.1	Starting and Run Up Current Testing Starting Point .....	15
6.9.2	Starting and Run Up Current Testing Finishing Point .....	15
6.10	Lamp Operating Limits .....	15
6.10.1	Lamp Voltage .....	15
6.10.2	Lamp Current .....	15
6.10.3	Lamp Power .....	16
6.11	Regulation .....	16
6.12	Extinction Voltage Test .....	17
6.12.1	Preferred Method .....	17
6.12.2	Alternate Method (No Reference Lamp Available) .....	17
6.13	Lamp Current Crest Factor .....	17
6.14	Ballast Power Loss .....	17
6.15	Input Power Factor .....	18
6.16	Ballast Factor .....	18
6.17	Hot Re-strike Time .....	18
6.18	Ballast Efficiency .....	18
6.19	Rise and Fall Time Measurement .....	18
6.19.1	Rise and Fall Time Generic Method of Measurement .....	18
6.19.2	Rise and Fall Time Linear Modeling Method of Measurement .....	19
<b>7</b>	<b>Mercury Lamp Constant Current Series Supply-type Transformer Measurements .....</b>	<b>19</b>
7.1	Input Circuit Measurements .....	19

7.1.1	Starting Conditions.....	19
7.1.2	Operating Conditions .....	19
7.2	Output (Lamp) Circuit Measurements .....	19
7.2.1	Starting Conditions.....	19
7.2.2	Operating Conditions .....	19
7.3	Power Supply .....	20
7.4	Transformer Input Connections.....	20
7.5	Lamp Operating Limits .....	20
7.6	Lamp Current Crest Factor .....	20
7.7	Ballast Power Loss.....	20
<b>8</b>	<b>Leakage Current Measurement.....</b>	<b>20</b>
8.1	General.....	20
<b>9</b>	<b>Temperature Rise Test (Bench Test) .....</b>	<b>20</b>
9.1	Electromagnetic Ballast, Rise Test (Bench Test).....	20
<b>10</b>	<b>Dielectric Tests.....</b>	<b>20</b>
10.1	General.....	20
10.2	Applied Potential Test (Hi Pot).....	20
10.3	Outdoors Transient Insulation Level (TIL) Test.....	20
10.3.1	Reactor Ballasts—Normal Power Factor .....	21
10.3.2	Reactor Ballasts—High Power Factor .....	21
10.3.3	Autotransformer Ballasts—Normal Power Factor (Lag) .....	21
10.3.4	Autotransformer Ballasts—High Power Factor (Lag) .....	21
10.3.5	Autotransformer Ballasts—Lead Type.....	21
10.3.6	Capacitors Used across Input Terminals of the Ballast.....	21
10.3.7	Insulated Winding Ballasts.....	22
10.4	Indoors Transients, Ring Wave Test.....	22
<b>11</b>	<b>End of Lamp Life Protection .....</b>	<b>22</b>
11.1	High Lamp Voltage Shutdown.....	22
<b>12</b>	<b>Spectral Power Ratio .....</b>	<b>22</b>
<b>13</b>	<b>Peak Current Ratio .....</b>	<b>23</b>
<b>14</b>	<b>DC Current .....</b>	<b>23</b>
<b>15</b>	<b>High-frequency Ripple Current.....</b>	<b>24</b>
<b>16</b>	<b>Inrush Current (NEMA 410 Applies) .....</b>	<b>24</b>
16.1	Indirect Verification.....	24
16.2	Inrush Current Model Basics.....	24
16.3	Inrush Current Model Calibration .....	24
16.3.1	Procedure .....	24
16.3.2	Analysis.....	25

16.3.3 Simulation Execution .....	25
16.4 Direct Testing Measurement .....	25
ANNEX A... Low-Frequency Electronic Reference Ballast .....	51

## Figures

Figure 1 HID Magnetic Reference Ballast .....	26
Figure 2 Multiple-circuit Ballast Test Connections.....	27
Figure 3 Current Slope ( $di/dt$ ) and Off Time (OT).....	28
Figure 4 Overshoot (OS) .....	29
Figure 5 Sustaining Voltage Measurement Wiring Diagram.....	30
Figure 6 Sustaining Voltage ( $V_{ss}$ ) .....	31
Figure 7 and Figure 8 Ballast Measurement Test Setup .....	32
Figure 9 Impulse Test Circuit for Reactor Ballasts .....	33
Figure 10 Impulse Test Circuit for Autotransformer Ballasts .....	33
Figure 11 Impulse Test Circuit for Autotransformer Ballasts—Lead Type .....	34
Figure 12 Impulse Test Circuit for Capacitors Used for Power Factor Correction .....	34
Figure 13 Impulse Test Circuit for Insulated Winding Ballasts .....	35
Figure 14 Peak Current Measurement Current Transformer.....	36
Figure 15 Peak Current Measurement Voltage Differential Probe Method .....	37
Figure 16 Superimposed Ignitor Pulses on Top of OCV eHID Ballast .....	38
Figure 17 Resonant Ignition eHID .....	39
Figure 18 LFSW Open Circuit Voltage .....	40
Figure 19 SPR Testing Method .....	41
Figure 20 Inrush Current One-Ballast and Multiple-Ballast Models .....	42
Figure 21 Pulse Height .....	43
Figure 22 Pulse Aggregation .....	44
Figure 23 Rise and Fall Times .....	45
Figure 24 Digital Calculation of Rise and Fall Times .....	46
Figure 25 Blackman Filter and SPR .....	47
Figure 26 100 ms FFT Window .....	48
Figure 27 199 Overlapping 1 ms Windows.....	48
Figure 28 Peak Current Ratio .....	49
Figure 29 High-frequency Ripple Current.....	50



## **1 Scope**

This Standard describes the procedures to be followed and the precautions to be taken in measuring performance of low-frequency ballasts (electromagnetic and electronic ballasts that operate at less than 400 Hz) for high-intensity discharge (HID) lamps. Deviations from the procedures given in this Standard are permissible for production or other testing provided that the methods used give results in substantial agreement with the method given herein. In case of doubt, reference shall be made to the specified methods to establish the validity of the results obtained by any alternate procedure.