



ANSI/NEMA C78.377-2017

American National
Standard for
Electric Lamps—
Specifications for
the Chromaticity of
Solid-State Lighting
Products



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





ANSI C78.377-2017

*American National Standard for Electric Lamps—
Specifications for the Chromaticity of
Solid-State Lighting Products*

Secretariat:

National Electrical Manufacturers Association

Approved: May 23, 2017

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.

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 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 17th Street, Suite 900
Rosslyn, Virginia 22209**

© 2017 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 a part of ANSI C78.377-2017)

Suggestions for improvement of this standard are welcomed. They should be sent to;

Secretary, ASC C78
National Electrical Manufacturers Association
1300 North 17th Street, Suite 900
Rosslyn, VA 22209

This standard was processed and approved for submittal to ANSI by Accredited Standards Committee on Electric Lamps, C78. Approval of the standard is not meant to imply that all Committee members voted to approve it.

CONTENTS

Foreword	ii
Introduction	1
1. Scope	1
2. Normative References	2
3. Definitions	2
4. Chromaticity	2
4.1 Basis	2
4.2 Nominal Cct And Target Cct	2
4.3 Specifications	2
Annex A 7-Step Quadrangles	5
Annex B 4 Step Quadrangles (Informative)	11
Annex C 4-Step u'v' Circles (Informative)	17
Annex D Conversions between CCT, Duv and (x, y) or (u', v') (Informative)	22
Annex E Extended Specifications (Informative)	26
Annex F Informative References	38

< This page intentionally left blank. >

Introduction

The purposes of this standard are, first, to specify the range of chromaticities recommended for general lighting with solid-state lighting products to ensure high-quality white light and, second, to categorize chromaticities with given tolerances so that the white light chromaticity of the products can be communicated to consumers. For this second purpose, the existing chromaticity standard (ANSI C78.376) for fluorescent lamps (FLRs) uses six nominal CCTs, some of which are given names such as Warm White (3000 K), Cool White (4100 K), and Daylight (6500 K). These names are often printed on product packages to communicate nominal CCT of the products to consumers. 2700 K and 5000 K, however, do not have names. Each of the six FLR lamp nominal CCTs has tolerances given as ellipses in the CIE 1931 (x, y) chromaticity diagram. Four-step MacAdam ellipses are used in ANSI C78.376, and seven-step MacAdam ellipses and seven-step quadrangles are used in the U.S. Environmental Protection Agency's (EPA) ENERGY STAR[®] specifications for Lamps, V2.0, and Luminaires, V2.0.

This chromaticity specification for LED products was developed to establish an alignment with the existing fluorescent lamp standards, enabling the consistent appearance of various light sources within spaces where multiple technologies are employed. The use of quadrangles to specify the chromaticities comprising the nominal CCTs increases the overall yield complying with this standard while acknowledging that chromaticities previously excluded (i.e. within the quadrangles but outside of the corresponding MacAdam ellipses) are nonetheless very useful in many applications.

This standard provides a basis for specifying chromaticity, explanation of a nominal CCT, target CCT, Duv, and details of SSL chromaticity requirements. In the 2014 revision, the specifications for nominal CCTs of 2200 K and 2500 K were added.

The annexes in this document provide the background information of this standard and tables and graphical representations of the specifications in this standard.

In this revision, extended specifications are added as options for products designed with chromaticity points that may be suitable for some lighting applications. This standard does not render a judgment on the preference, perception of white or natural light. This ANSI standard simply extends the designation of chromaticity regions to include areas that are suitable for some lighting applications. The Extended Specification given in Table 2 is developed as a straightforward mathematical construct to expand the ANSI chromaticity specification. This standard specifies only standardized chromaticity regions and does not relate to color quality metrics such as fidelity, chroma saturation or color discrimination.

1 Scope

The purpose of this standard is to specify the range of chromaticity for general lighting with solid-state lighting (SSL) products, as well as to ensure that the chromaticity of the products can be communicated to consumers. This standard applies to LED lamps, LED light engines and LED luminaires for general indoor lighting applications, and may apply more broadly.

This document does not apply to lighting fixtures sold without a light source. This standard also does not apply to SSL products for some indoor applications that intentionally produce colored light. This document does not include OLED products.

1.1 Patent Disclaimer

At the time of publication, it is possible that some of the elements of this document may be the subject of patent rights. When this Standard was approved for publication, the Accredited Standards Committee C78 and the National Electrical Manufacturers Association (NEMA) did not know of any patent