

Shining a Light on the Future:

New and Developing Lighting Standards Relevant to ENERGY STAR[®]

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Caution

Standards development is a dynamic process with input from many stakeholders.

New standards & revisions often have different outcomes than originally anticipated at project fruition.

It is strongly recommended that you not make business or design decisions based upon standards in draft.

The following is an overview only.



Published Standards, Methods of Measurement, and Technical Memoranda

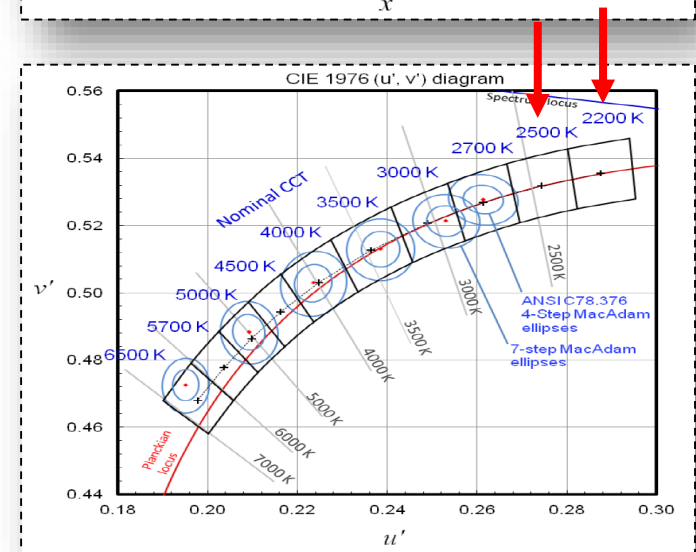
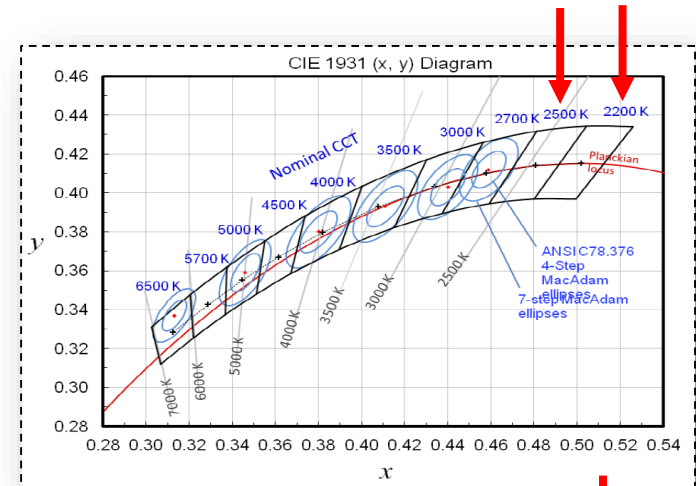
ANSI

C78.377-2015: Specifications for the Chromaticity of Solid State Lighting Products

Status: third revision [published](#) in July

Scope: indoor LED lamps & luminaires, also de facto global standard for LED package binning

- Keeps existing ANSI nominal CCTs 2700 through 6500 Kelvin, adds 2200 and 2500 Kelvin
- Maintains quadrangles in CIE 1931 (xy) and 1976 (u'v') color spaces
- Adds provisions for developing 4-step quadrangles around the same center points
- Maintains “flexible CCT” provisions
- Adds provisions for developing 4-step circles, per CIE TN 001:2014



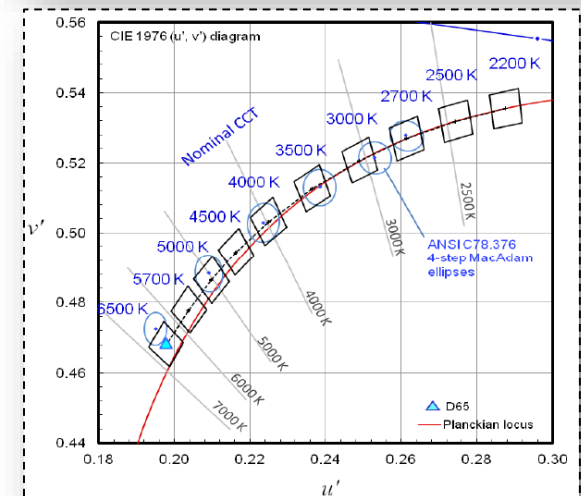
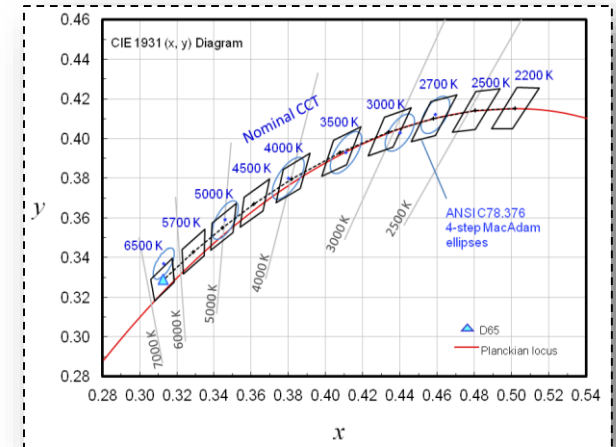
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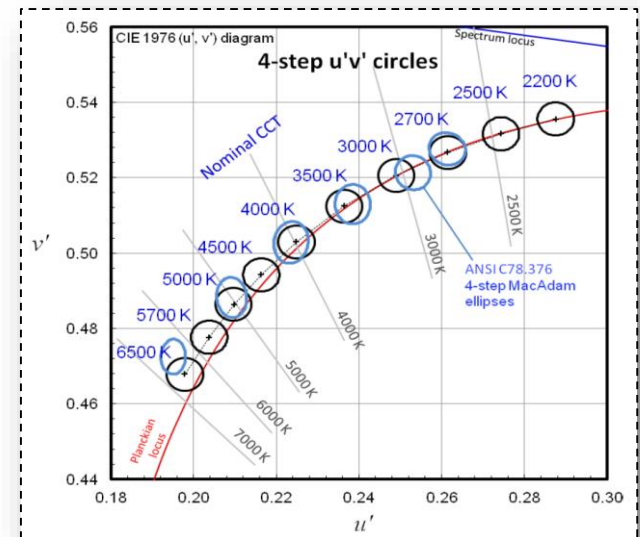
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ANSI



C78.374-2015: Light Emitting Diode Package Specification Sheet for General Illumination Applications

Status: first edition in press

Scope: new American National Standard, specifies white LED package specification sheets, to communicate between package manufacturers and general illumination application users

- Not directly relevant to ENERGY STAR program, but relevant to its manufacturing partners
- Graphs are to be constructed in linear scale to enable data comparability
- Graphs are to be constructed to optimize machine scanability (no background, legends placed outside graph)
- IEC TC34 considering this document as the basis for a new international standard
- Includes:
 - CCT versus luminous flux
 - Color binning (per ANSI C78.377)
 - Spectral power distribution
 - Luminous intensity distribution
 - Luminous flux versus forward current
 - Luminous flux versus temperature
 - Operating limits
 - Thermal & electrical characteristics
 - Forward voltage versus forward current
 - Forward current versus temperature
 - Forward voltage versus temperature
 - Mechanical characteristics
 - Electrical diagram
 - Product handling recommendations
 - LED packing information

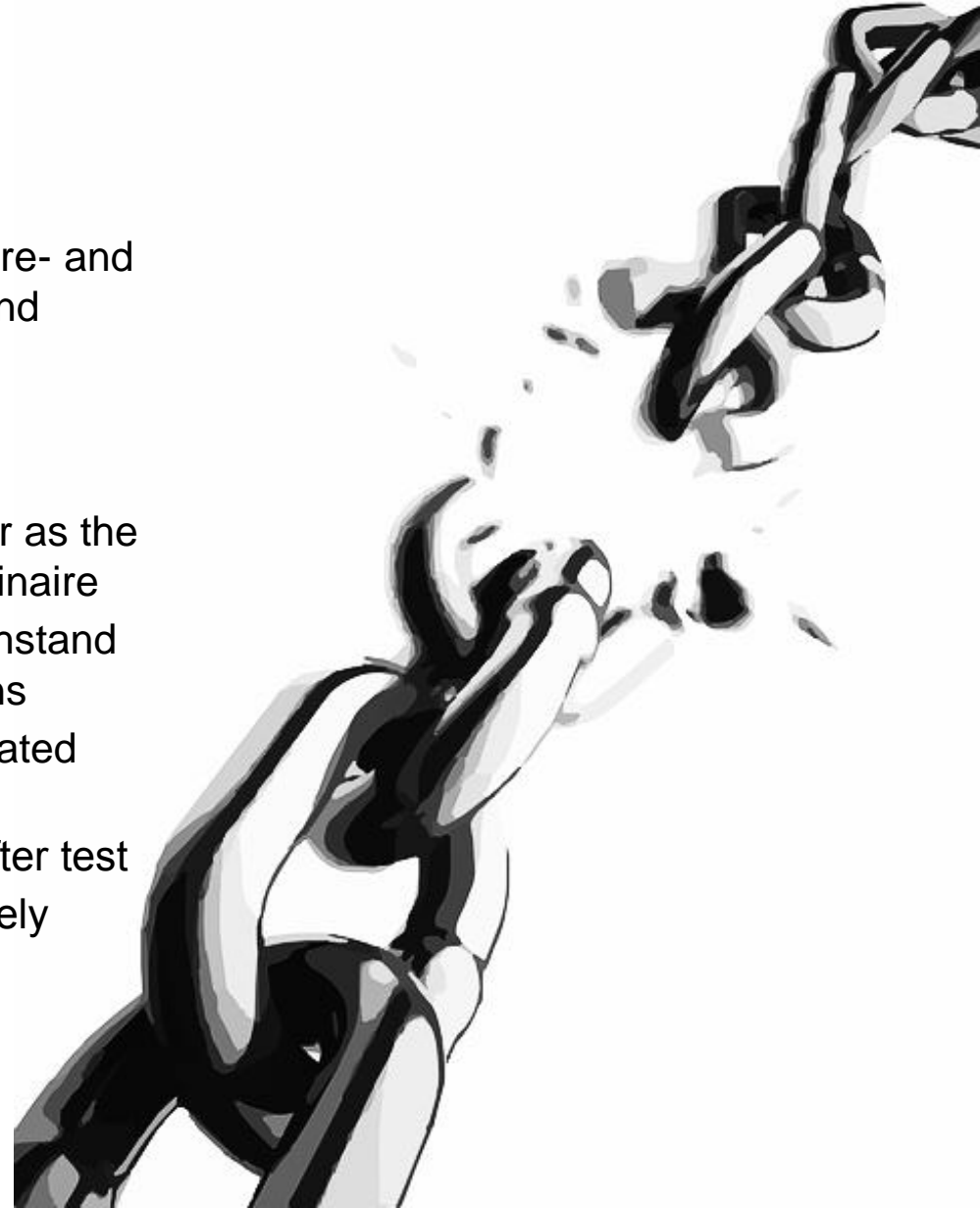
ANSI

C82.15: LED Driver Robustness

Status: first edition in press

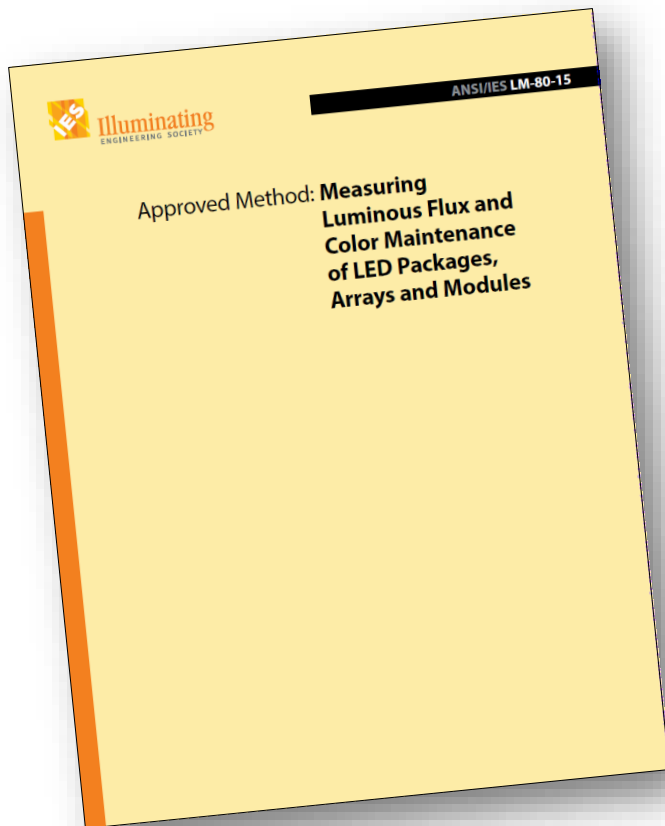
Scope: testing methods to evaluate hardware- and software-based LED driver ability to withstand stress, to define a high level of robustness

- First of its kind for the lighting industry
- May fill a longstanding gap: the LED driver as the potential weak point in an LED lamp / luminaire
- Robustness is defined as the ability to withstand or overcome variable or adverse conditions
- Defines Failure Types (A, B, C, D) and related Acceptability Criteria
 - “A”: operates as intended during and after test
 - “D”: permanently damaged but fails safely



ANSI / IES

LM-80-15: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules



Status: first revision (2015) published

Scope: now includes luminous, photon and radiant flux maintenance, with chromaticity shift over time

- Now an American National Standard
- Heavily relied upon by ENERGY STAR program
- Incorporates changes from LM-80-08 Addendum A
 - Min 3 case temperatures reduced to 2
 - ± 48 hour temporal tolerances on measurement intervals
- PWM current, DC constant voltage and AC regulated voltage drive
- Maintenance test duration and measurement interval no longer specified
- Referenced in IEC 63013: LED packages – Long-Term Luminous Flux Maintenance Projection (in draft)

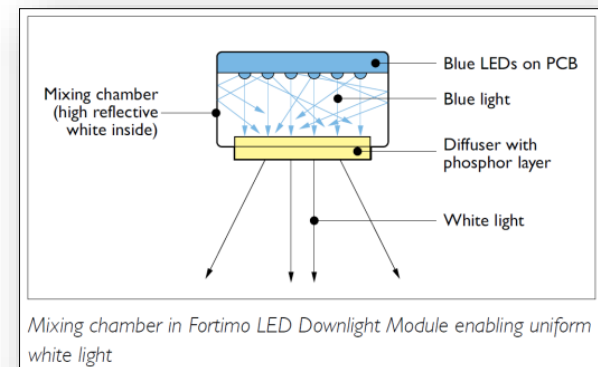
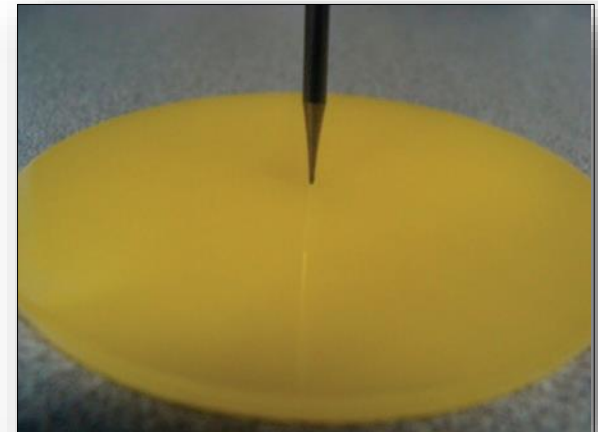
IES

LM-86-15: Measuring Luminous Flux and Color Maintenance of Remote Phosphor Components

Scope: Method for measuring long-term degradation of “remote phosphor components”

Status: in press

- Unique IES method in that it evaluates a non-electrical lighting component
- “Remote phosphor component” is an element of any shape, mechanically separable from pump LED source(s) containing one or more phosphor materials
- A “pump LED source” is an LED irradiance source which excites the remote phosphor component to produce white light
- Luminous flux & color maintenance can now be measured and reported at each integration level:
 - LM-80: LED package / array / module
 - LM-84: LED lamp or luminaire
 - LM-86: remote phosphor component (only)



Philips Lighting

IES

TM-21-11 Addendum B

Status: just published last week

Scope: replaces Addendum A entirely

- Makes no content changes
- Addendum A had several serious problems:
 - Lack of preamble language instructing user on which language is intended to control: the original, or the Addendum
 - If the Addendum controls, then important original language about data sets > 10,000 hours is no longer present, creating confusion for the reader

This Addendum replaces specified sections in document *IES TM-21-11* based on the post-publishing practice and users' inputs. This Addendum supersedes and nullifies the statements made in Addendum A for TM-21-11: Projecting Long Term Lumen Maintenance of LED Packages.

Addendum B for TM-21-11: Projecting Long Term Lumen Maintenance of LED Light Sources

If you, as a user of IES's TM-21-11, believe you have located an error not covered by the following revisions, you should e-mail your information to Pat McGillicuddy, pmcgillicuddy@ies.org or send a letter to Pat McGillicuddy, Manager of Technology, IES, 120 Wall St. 17th Floor, New York, NY 10005. Additions will be posted to this list online as they become available. This errata list was last updated October 5, 2015.

This Addendum replaces specified sections in document *IES TM-21-11* based on the post-publishing practice and users' inputs. This Addendum supersedes and nullifies the statements made in Addendum A for TM-21-11: Projecting Long Term Lumen Maintenance of LED Packages.

4.3 Luminous Flux Data Collection and Selection

Additional measurements after the initial 1000 hours at intervals smaller than 1000 hours (including every 1000 hour points) are encouraged. Additional measurements beyond 6000 hours are encouraged and will provide the basis for more accurate lumen maintenance predictions.

Data collected within a ± 48 hour window of each "1000 hour measurement point", e.g., from 952 hours to 1048 hours, from 1952 hours to 2048 hours, etc., are acceptable for use in product lumen maintenance projections. The ± 48 hour window is also applicable to other intervals smaller than 1000 hours. The exact time designation shall be used in the projection calculation.

5.2.3 Data Used for Curve-fit

For data sets of test duration, D , from 6000 hours up to 10000 hours, the data used for the curve-fit shall be the last 5000 hours of data. Data before the 1000 hour reading shall not be used for the curve fit.

Data collected within a ± 48 hour window of each "1000 hour measurement point", e.g., from 952 hours to 1048 hours, from 1952 hours to 2048 hours, etc. shall be acceptable as each "1000 hour reading" and shall be used for luminous flux maintenance projection with the actual measured elapsed time value. The ± 48 hours window is also applicable to other intervals smaller than 1000 hours. The actual measured elapsed time values shall be used in the projection calculation.

The data collection points used in the projection calculation shall be equally dispersed in time (to within ± 48 hours). No two consecutive data collection intervals after the initial 1000 hours shall differ by more than 96 hours in length. For example, data may be used in the projection calculation which are collected every 1000 hours (± 48 hours), every 500 hours (± 48 hours),

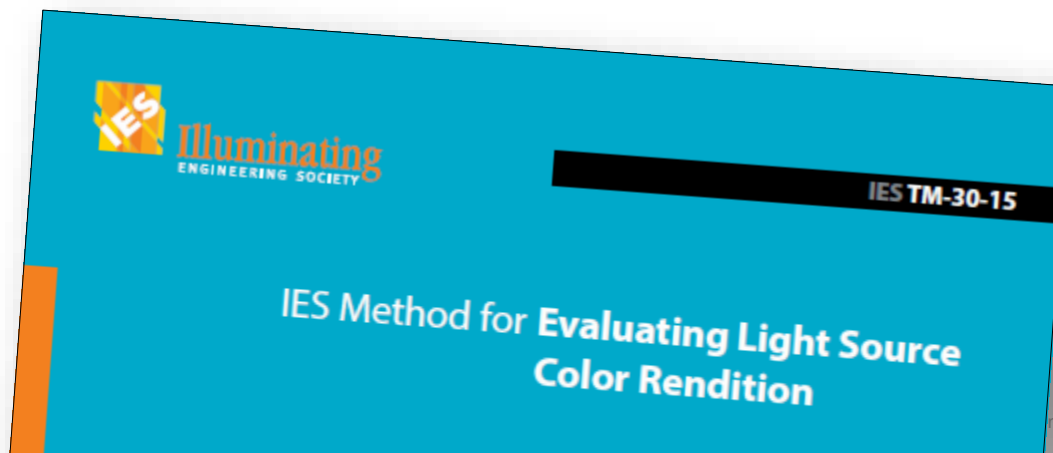
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TM-30-15: Evaluating Light Source Color Rendition

Status: first edition published

Scope: a new Technical Memorandum for evaluating white light sources and systems for indoor general illumination and outdoor at photopic light levels

- Not a standard, not a regulation
- Well vetted by illumination and perception experts
- Lighting industry reaction is one of caution:
 - IES Position Statement: [IES PS-8-15](#)
 - Global Lighting Association: 18 September [Position Statement](#)
 - NEMA white paper in development



Standards, Methods of Measurement, and Technical Memoranda In Development

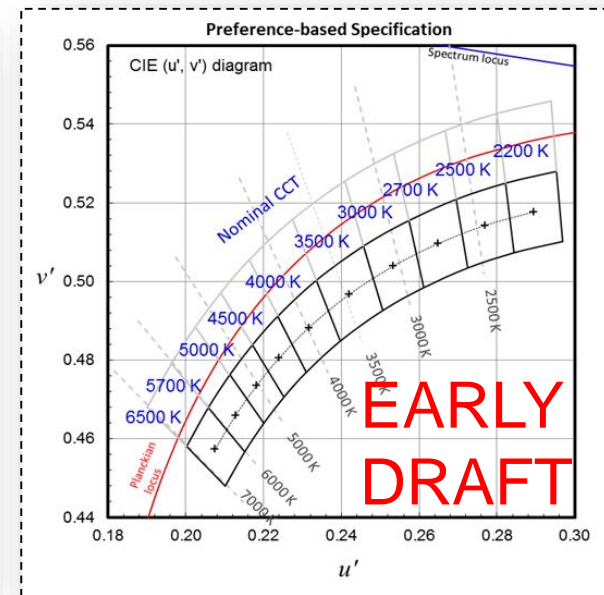
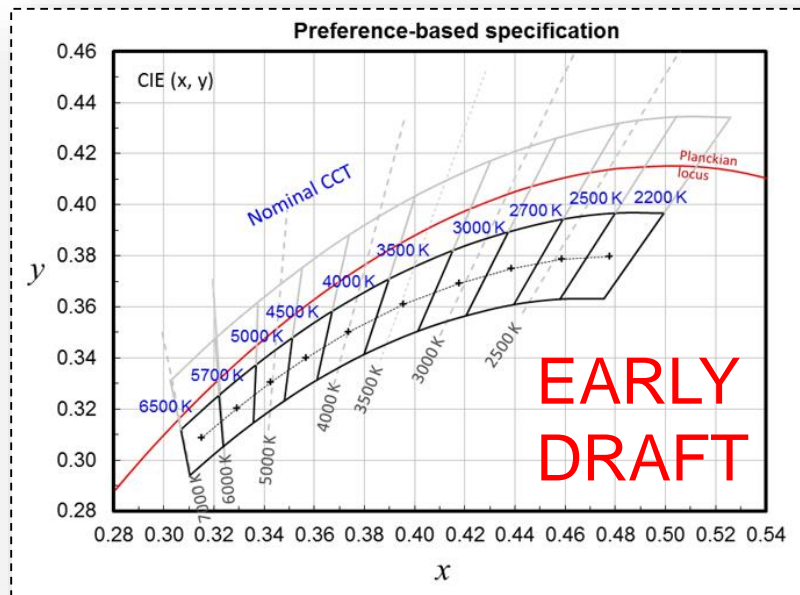
ANSI

C78.377-201x: Specifications for the Chromaticity of Solid State Lighting Products

Status: ANSLG Committee 78 ad hoc #28 developing new ANSI standard quadrangles for white light chromaticities below the black body locus

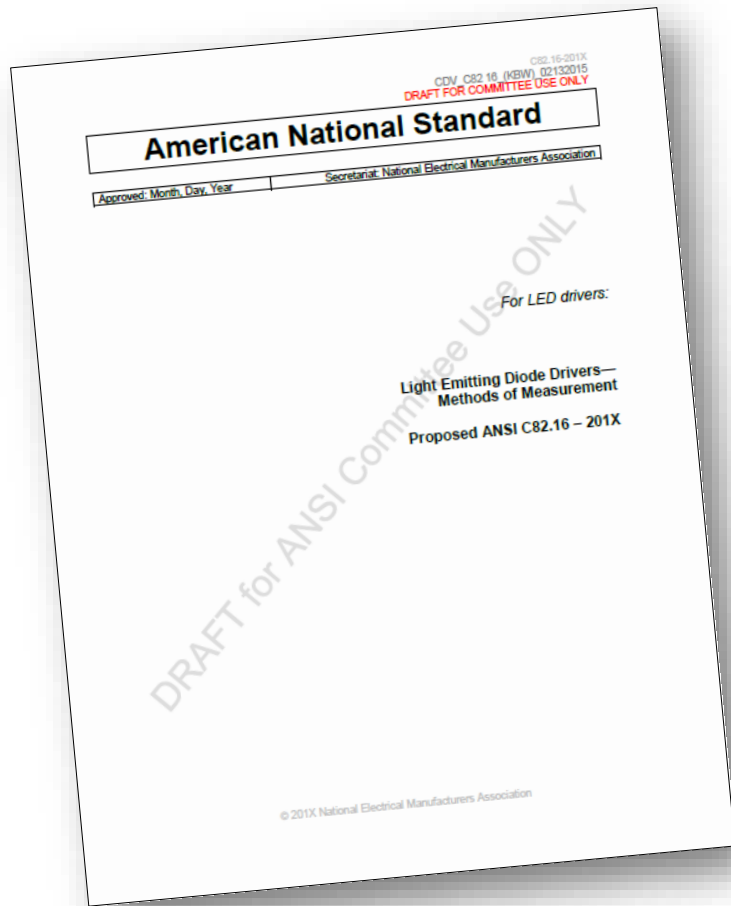
Scope: expansion of 2015 scope

- Working group evaluating research by the Lighting Research Center and NIST indicating observer preference for white light chromaticities below the black body locus



ANSI

C82.16: Light Emitting Diode Drivers — Methods of Measurement



Status: first edition in committee

Scope: method of measurement for LED driver performance for general, exterior and roadway lighting

- Up to 600 VDC or VAC
- Constant-current or constant-voltage DC output
- Fixed, variable, PWM, or programmable output power
- External (standalone) or internal (enclosed in luminaire)
- Measurements are very thorough, too numerous to detail here

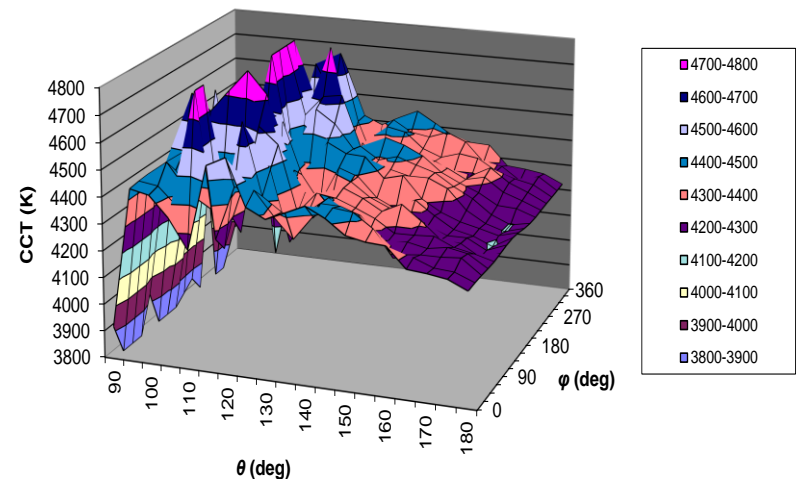
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LM-79-1x: Method for the Electrical & Photometric Measurement of Solid-State Lighting Products

Status: first revision in development

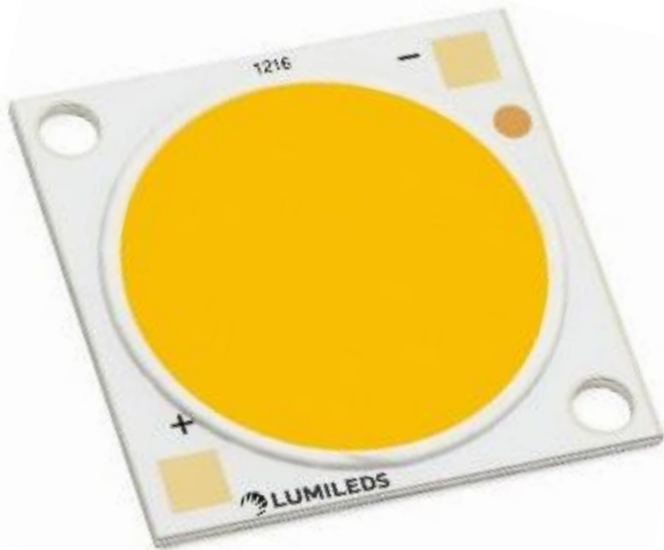
Scope: LED luminaires and integrated lamps for illumination operating on AC mains or DC voltage power supply

- Making subtle improvements based on industry experience with 2008 document, to help labs avoid common pitfalls, without disruption to global regulatory references
 - method for laboratories to validate their color angular uniformity measurements, e.g. lowest light level at which results are valid
 - adding ballast to electrical circuit, switched in and out to determine product sensitivity to impedance effects (90% of the market is not sensitive)
- Table of contents changing to new IES LM format
 - Section number references will change, may create minor disruptions in laboratory accreditation documentation (e.g. currently section 9 is integrating sphere, section 10 is goniophotometers)



IES

LM-87-1x: IES Approved Methods for Robustness Tests for LEDs



Status: in draft, highly contested

Scope: method for robustness testing of LED packages

- Not directly relevant for ENERGY STAR, more for manufacturing partners
- Real departure for the IES, heading into reliability territory historically handled by JEDEC
- Redundant to IEC/TS 62861 Ed. 1: Guide to Principal Component Reliability Testing for LED Light Sources and LED Luminaires
 - unclear what this document will accomplish beyond IEC 62861 and its JEDEC references
- Includes:
 - HTOL (high temperature operating life)
 - TMCL (temperature cycling)
 - RSH (resistance to soldering heat)
 - WHTOL (wet high temperature operating life)
 - ESD (electrostatic discharge test)
 - Continuous switching cycles until failure test

IES

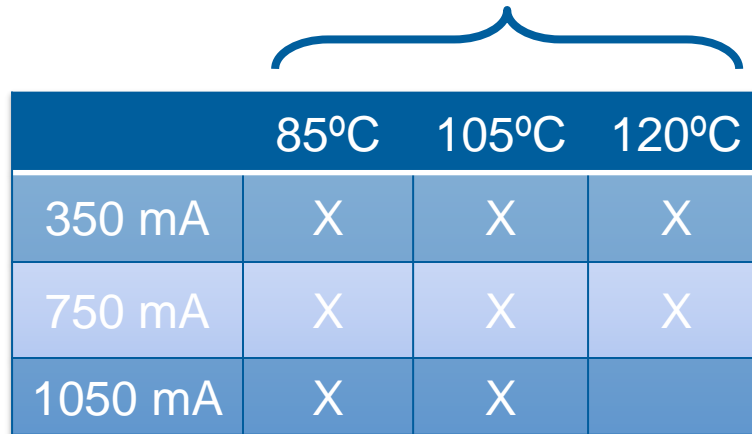
TM-21-1x: Projecting Long Term Lumen Maintenance of LED Light Sources

Status: first revision in development

Scope: expansion of existing to include drive current interpolation method, and to incorporate changes made in Addendum B

- Data show that for LM-80 data for some LED packages, with case temperature held constant, some lumen depreciation can be a function of drive current
- Working group exploring drive current interpolation for potential addition to 201x revision

2011 publication:
temperature interpolation (only)



| | 85°C | 105°C | 120°C |
|---------|------|-------|-------|
| 350 mA | X | X | X |
| 750 mA | X | X | X |
| 1050 mA | X | X | |

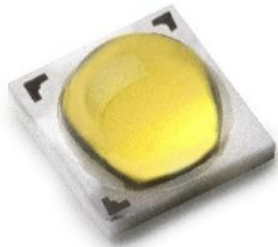
201x revision:
will add drive current
interpolation

IES

TM-31: Projecting Long-Term Color Maintenance of LED Packages, Arrays and Modules

Status: working group just recently formed

Scope: developing chromaticity projection method(s) using LM-80 chromaticity data



- Data submitted by multiple manufacturers for multiple LED package types (high power, plastic mid-power, ‘chip on board’, etc)
 - Data anonymized by NIST
- Anticipated that different package types will require different algorithms
 - E.g. mid-power packages have different degradation mechanisms compared to high power
- Publication anticipated in late 2017

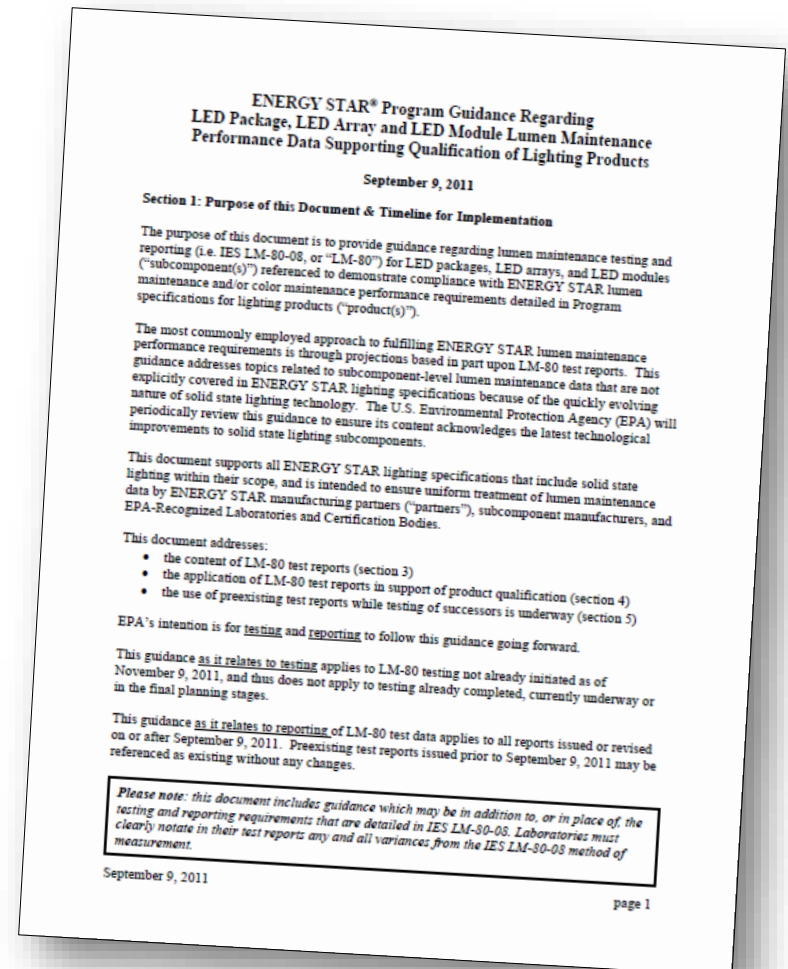
IES

TM-3x (S0417): Parametric Variations Informing the Application of Luminous Flux Maintenance Test Reports for Luminous Flux Maintenance Projections

Status: proposal (PIF) being finalized for ballot, Technical Coordinator is yours truly

Scope: LED packages/arrays/modules tested per IES LM-80-15 (includes white and single color LED packages)

- Will document expert consensus on LED package variations (e.g. materials, construction, assembly processes) that affect LM-80 test results, and by extension TM-21 projections
- Intended to provide guidance that can be used by market transformation programs, certification schemes, market actors, regulators
- Could be used in place of ENERGY STAR Lumen Maintenance Guidance





Thank You

Contact

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