



Bringing Efficiency to Light<sup>SM</sup>

# **SSL Version 5.0**

Draft 2

October 16, 2019

# Presenters – DLC Team



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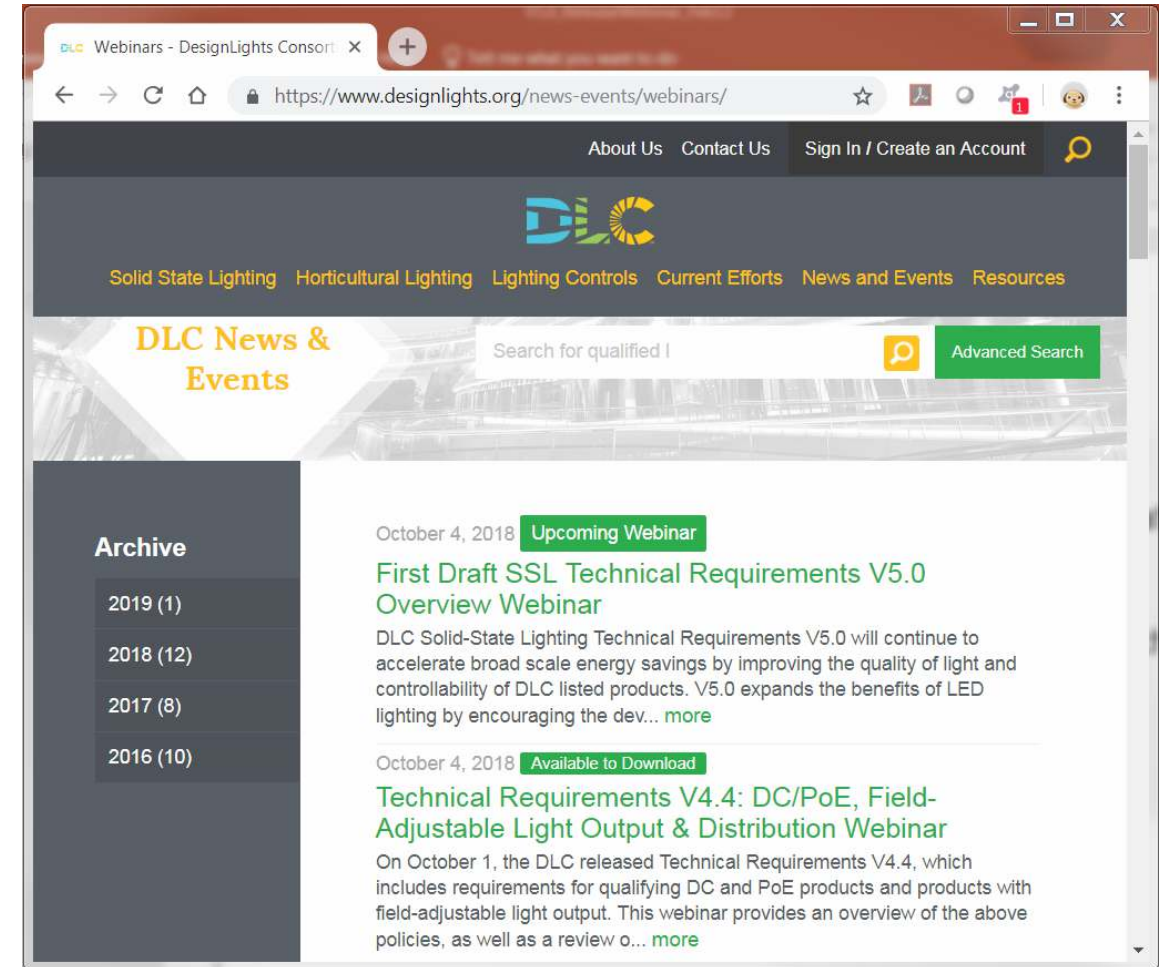
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# Agenda

- Introduction
- Efficacy
- Spectral Quality
- Flicker
- Distribution and Glare
- Controllability
- Premium
- Additional reporting guidelines
- Allowances and tolerances
- THD and power factor
- Reference housings
- Implementation
- Q&A – 30 mins

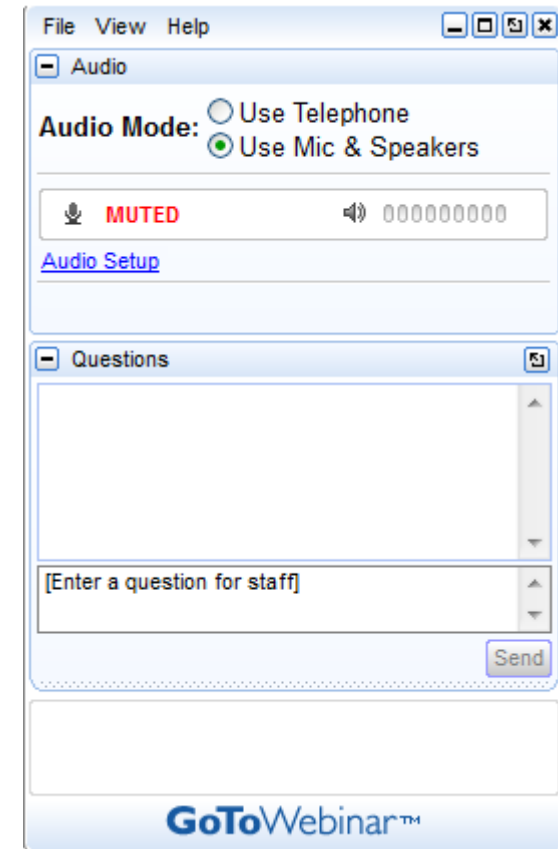
# Webinar Logistics

- **Slides and recorded webinar will be posted** on the *DLC News & Events* page at [www.designlights.org](http://www.designlights.org) shortly after today's presentation
- All attendees are automatically muted
  - If you experience technical issues, please use the chat feature to let us know



# Questions and Answers

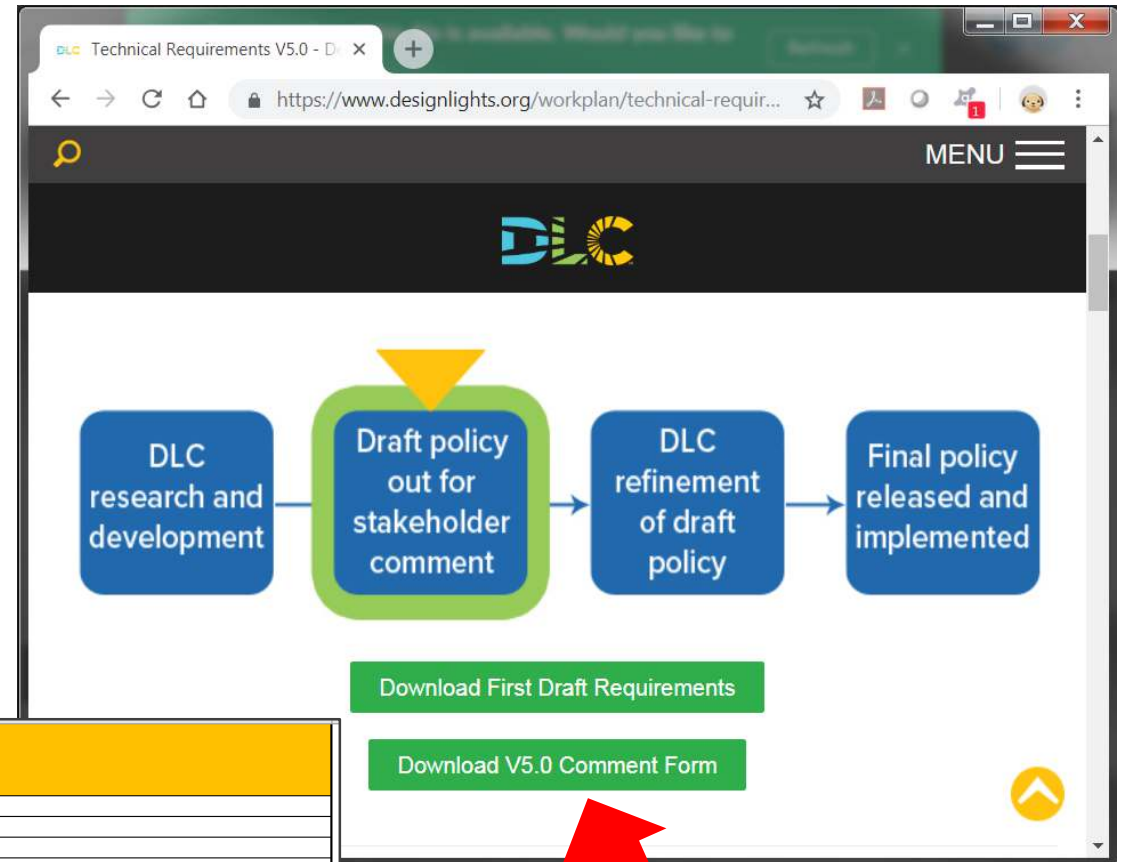
- We will leave **30 minutes** after the presentation to answer questions. Please enter your Questions pane in GoToWebinar.
  - DLC technical support team will answer clarifying questions as they come in via the questions pane
  - Some questions will be saved until the end to read aloud during the Q&A session





# Comment Forms

All comments must be submitted using DLC Comment Forms. Please download the Comment Form and submit the completed forms to [comments@designlights.org](mailto:comments@designlights.org)



DLC Comment Form Instructions			
<b>Document:</b> Solid-State Lighting (SSL) Technical Requirements Version 5.0			
<b>Version:</b> Draft 1 of SSL V5.0			
<b>Comments Due:</b> Close of business, Tuesday March 12, 2019			
<b>Instructions and Background:</b>	<b>Please follow these steps to ensure your comments are received and considered by the DesignLights Consortium:</b>		
	1. Enter your Organization, Name, Email Address, and Phone Number in Row 8 of this worksheet.		
	2. Navigate to the tab at the bottom of this worksheet corresponding to the section of the V5.0 draft on which you'd like to comment.		
	3. After your review of the draft document, please consider each Key Question in Columns B, C, and D and submit your answer in Column E. Comments to the Technical Requirements that are not related to a specific Key Question may be added at the bottom of each worksheet. Please enter the line number of the draft corresponding to your comment into Column B starting on Row 16.		
	4. Comments to the Technical Requirements that are not related to a specific section or topic may be added at the "General Comments" tab.		
	5. Save this Excel file with your comments and include your organization name appended to the end of the filename (for example: "DLC_V5.0Draft1_CommentForm_ABCLightingCo").		
6. Email the file to <a href="mailto:comments@designlights.org">comments@designlights.org</a> by close of business, <b>Tuesday March 12, 2019</b> .			
<b>Reviewer Organization</b>	<b>Reviewer Name</b>	<b>Reviewer Email Address</b>	<b>Reviewer Phone #</b>

# V5.0 – Draft 2



# SSL Technical Requirements V5.0

First of a series of specifications to improve quality of light and connectivity

V5.0 introduces new quality metrics to align with current research and industry readiness

Future specifications (V5.1, V6.0, etc.) will continue quality and connectivity focus

# Goals of this Version



The efficacy of listed products increases by an average of 10.8%, and up to 23% for some categories of lighting



Virtually all listed indoor luminaires and retrofit kits are dimmable, providing increased energy savings and more user satisfaction



V5.0 color quality requirements help provide people the lighting they want with more color consistency over time



Lighting decision makers can use DLC Premium classification to have better confidence in the glare performance of listed products

# Responsive to Stakeholder Comments



Draft 1 received over 1,000 comments from 46 organizations

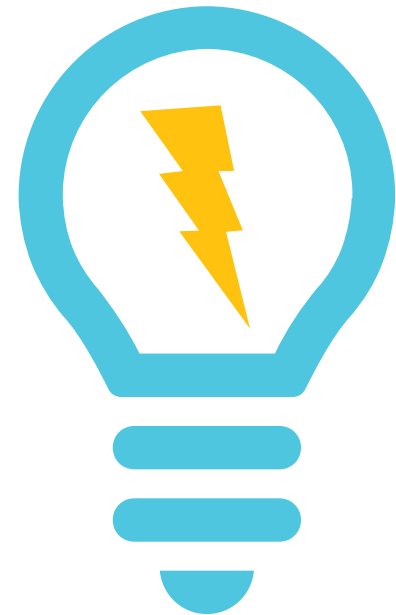
Draft 2 responds to these comments:

- Simplifies the policies
- Includes specific testing and implementation details
- Reduces testing burden
- Addresses application specific concerns
- Includes DLC Premium and Efficacy Allowance proposals

# Efficacy

# Draft 2: Efficacy Requirements

- The proposed efficacy increases intend to **balance energy savings, product cost, and quality of light**
- Draft 2 values represent a DLC Standard classified product-weighted **average increase of 10.8%**
- DLC Premium under Draft 2 is proposed as a **flat 15-point increase over standard**



# Draft 2: Efficacy Requirements

General Application		Standard (lm/W)		Premium (lm/W)	
		V4.4	V5.0	V4.4	V5.0
Indoor	Troffer	100	110	125	125
	Linear Ambient	105	115	130	130
	High-Bay	105	120	130	135
	Low-Bay	n/a	115	n/a	130
	Case Lighting	80	95	125	110
	Interior Directional	65	80	90	95
Outdoor	Low Output	90	105	110	120
	Mid Output	95	105	115	120
	High Output	100	105	120	120
	Very High Output	100	105	120	120
Lamps	Linear Replacement	110	120	n/a	n/a
	4-pin CFL Replacement	75	85	n/a	n/a

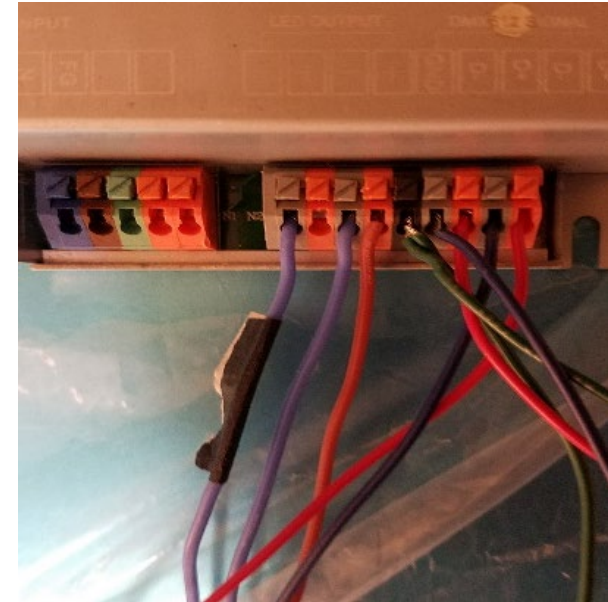
# Quality of Light

## Spectral Quality



# Spectral Quality Rationale

- Color quality
  - influences **task performance**.
    - Recognizing differences quickly and accurately.
  - is related to occupant **safety**.
    - Distinguishing color related information.
  - is a major factor in **aesthetics**.
    - Appreciating art and design.
  - is critical for **wellbeing**.
    - Experiencing visual comfort and supportive atmosphere.



# Spectral Quality Requirement Considerations

The DLC seeks spectral requirements that:

- Align with industry organizations, practices and guidelines
- Distinguish products that meet a minimum acceptable level of performance
- Enable differentiation of products that provide superior color quality performance for applications and projects that require it
- Don't place excessive burden or expense on applicants

# Spectral Quality: Feedback and Changes

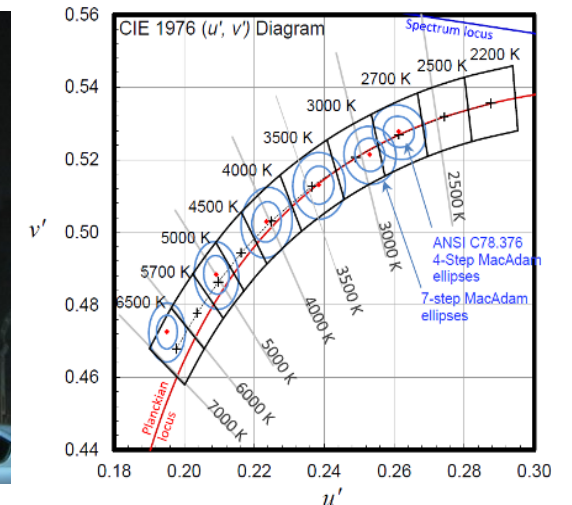
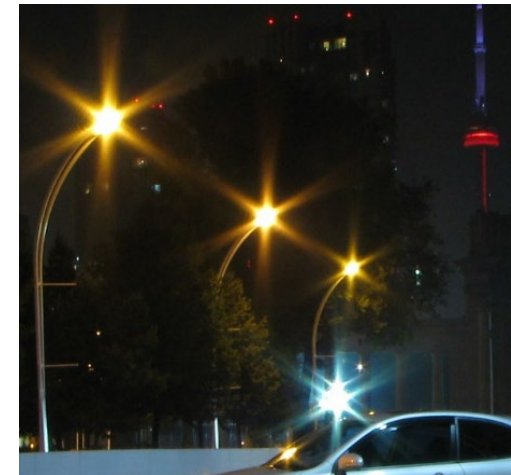
- Testing burden associated with multiple metrics is too high
  - **Removed** optional reporting and testing for **Angular Color Uniformity**
  - **Removed** required reporting and testing for **Consistency (of Chromaticity)**
- Some applications need specific requirements
  - Proposed **specific requirements for outdoor and high-bay** lighting
- Tiering, Allowances, and Premium and their interactions are not clearly explained
  - **Eliminated proposed tiers** from Standard qualification
  - Proposed **efficacy allowances** for meeting more preferential color rendition thresholds
  - Proposed **stricter** color maintenance and binning **requirements for Premium qualification**
- Uncertainty and lack of consensus around circadian metrics
  - Removed any considerations not specifically related to color quality, i.e. **circadian considerations removed**

# Draft Testing and Reporting Requirements

Metric and/or Application	Current V4.4 Requirements	V5.0 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
<a href="#">Chromaticity (CCT &amp; D<sub>uv</sub>)</a>	Products shall exhibit chromaticity consistent with at least one of the basic, nominal, 7-step quadrangle CCTs ≤ 5000 K (indoor) and CCT ≤ 5700 K (outdoor & high bay)	Products shall exhibit chromaticity consistent with at least one of the basic or extended nominal, 7-step quadrangle CCTs from 2200K – 6500K	CCT and D <sub>uv</sub> for parent products that are from LM-79 test reports will be listed as Tested Data.  Nominal CCT for child products will be listed as Reported Data.	ANSI/IES LM-79 ANSI C78.377-2017 (See <a href="#">Draft Additional Reporting Guidelines</a> for required information)

## Color of Light (Chromaticity, D<sub>uv</sub> & CCT):

- Expanding CCT range to 2200 – 6500 K per ANSI C78.377-2017
- Efficacy allowance available for ≤ 2700 K
- V5.0 Premium Draft requirements are set to improve overall binning of products across any given CCT



Source: ANSI C78.377-2017

# Draft Testing and Reporting Requirements

Metric and/or Application	Current V4.4 Requirements	V5.0 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
<a href="#">Color Rendition</a>	CRI (CIE 13.3-1995): $R_a \geq 80$ (indoor)	<i>Indoor, except high-bay:</i> <b>Option 1 - ANSI/IES TM-30-18:</b> <ul style="list-style-type: none"> <li>IES <math>R_f \geq 70</math></li> <li>IES <math>R_g \geq 89</math></li> <li><math>-12\% \leq \text{IES } R_{cs,h1} \leq +23\%</math></li> </ul> <b>Option 2 - CIE 13.3-1995:</b> <ul style="list-style-type: none"> <li><math>R_a \geq 80</math></li> <li><math>R_g \geq 0</math></li> </ul>	<p>All color rendition metrics for parent products that are from LM-79 test reports will be listed as Tested Data.</p> <p>All color rendition metrics for child products will be listed as Reported Data.</p>	<p>ANSI/IES LM-79 ANSI/IES TM-30-18 CIE 13.3-1995</p> <p>(See <a href="#">Draft Additional Reporting Guidelines</a> for required information)</p>
	CRI (CIE 13.3-1995): $R_a \geq 65$ (outdoor) $R_a \geq 70$ (high bay)	<i>Outdoor and high-bay:</i> <b>Option 1 - ANSI/IES TM-30-18:</b> <ul style="list-style-type: none"> <li>IES <math>R_f \geq 70</math></li> <li>IES <math>R_g \geq 89</math></li> <li><math>-18\% \leq \text{IES } R_{cs,h1} \leq +23\%</math></li> </ul> <b>Option 2 - CIE 13.3-1995:</b> <ul style="list-style-type: none"> <li><math>R_a \geq 70</math></li> <li><math>R_g \geq -40</math></li> </ul>		

## Color Rendition (of Objects):

- Standard (indoor) requirements align with Preference tier 3 (P3) of IES TM-30 recommendations
- Outdoor TM-30 requirements proposed, generally align with  $R_a=70$  and  $R_g=-40$



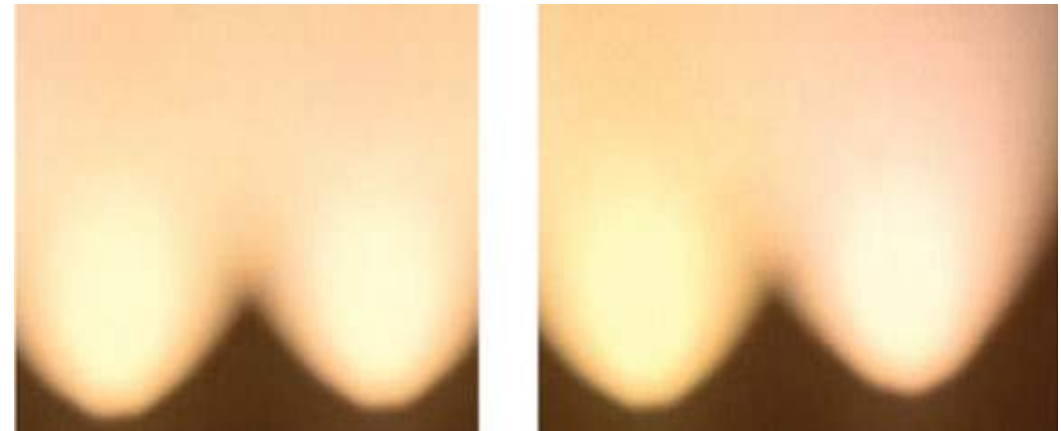
Source: Don Slater, NightTime Design

# Draft Testing and Reporting Requirements

Metric and/or Application	Current V4.4 Requirements	V5.0 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
<a href="#">Color Maintenance</a>	None	<i>Indoor, except high-bay:</i> Chromaticity shift from 1,000-hour measurement to 6,000-hour measurement shall be within a linear distance of 0.004 ( $\Delta u'v' \leq 0.004$ ) on the CIE 1976 ( $u', v'$ ) chromaticity diagram.	Color maintenance information will not be listed on the QPL at this time.	ANSI/IES LM-80, and/or IES LM-84-14
		<i>Outdoor and high-bay:</i> Chromaticity shift from 1,000-hour measurement to 6,000-hour measurement shall be within a linear distance of 0.007 ( $\Delta u'v' \leq 0.007$ ) on the CIE 1976 ( $u', v'$ ) chromaticity diagram.		

## Color Maintenance:

- Chromaticity shift between 1000 hours and 6000 hours evaluated against proposed  $\Delta u'v'$  requirement
- Stricter requirements for Premium qualification of indoor and outdoor products



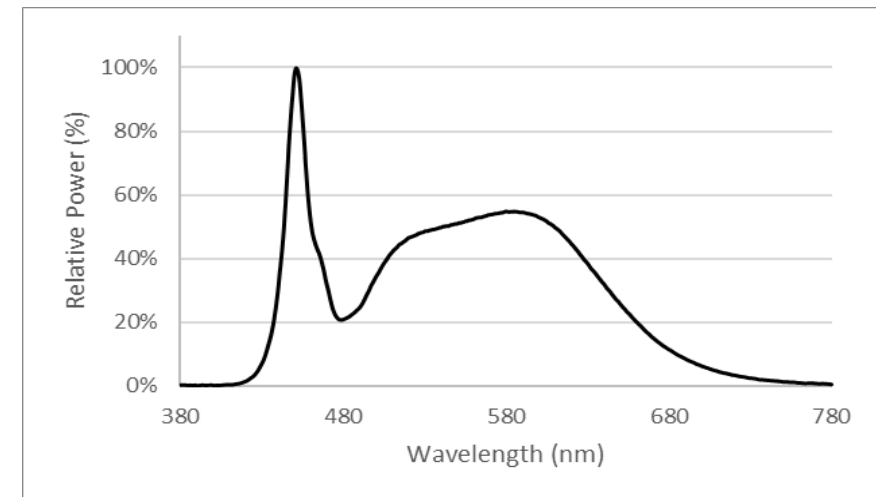
Source: IES DG-1-16 (Figure 50, Maria Thompson)

# Draft Testing and Reporting Requirements

Metric	Current V4.4 Requirements	V5.0 Draft Requirements	Method of Evaluation
Spectral Power Distribution (SPD)	n/a	Spectral range of 380 – 780 nm at 1 nm increments must be reported.	ANSI/IES LM-79 (per IES TM-27-14 and/or ANSI/IES TM-33-18)

## Spectral Power Distribution (SPD):

- Required reporting of the SPD derived from sphere testing in each “complete LM-79/color report”
- Spectral power distribution data will be for DLC internal use only and will not be published on the QPL





# Quality of Light

## Flicker

# Flicker Rationale

- Flicker free operation is a critical component of **visual comfort**
  - Can cause annoyance, loss in productivity
- Flicker has **health impacts**
  - Can lead to eye strain, migraines, anxiety, photo epilepsy, exacerbate undesirable behaviors among persons with autism
- Flicker can cause **dangerous industrial working environments**
  - Rotating machinery can appear still
- Flicker can **interfere** with machine vision and imaging devices
  - E.g. barcode scanners, sensors, video feeds

# Flicker: Feedback and Changes

- Testing burden associated with luminaire-level testing
  - Testing now performed on a single model
- Uncertainty and lack of consensus around flicker metrics and thresholds
  - Requirements are now reporting-only
- Interactions between dimmers and drivers need to be carefully considered
  - No requirements around dimmers; only reported
- Application specific requirements

# Draft 2: Flicker Requirements

Metric	Current V4.4 Requirements	Draft V5.0 Requirements	Listing	Method of Evaluation
Short Term Flicker (P <sub>st</sub> )	n/a	Report values at 100% and 20% of light output	Flicker information will not be listed on the QPL at this time.	ANSI/IES LM-xx-19 Approved Method: Measuring Optical Waveforms for use in Temporal Light Artifact (TLA) Calculations
Stroboscopic Visibility Measure (SVM)				
Percent Flicker				
Flicker Index				

DLC Premium: No additional requirements beyond DLC standard

# Quality of Light

## Distribution and Glare

# Distribution & Glare Rationale

- Light Distribution can impact **energy consumption**
  - Minimizing wasted light
- Distribution and Glare influence **task performance**
  - Quantity and uniformity of light to optimize visual performance
- Distribution and Glare can impact occupant **safety**
  - Visibility for navigation and detecting obstacles
- Distribution and Glare can impact **wellbeing**
  - Supporting comfort without eye strain and annoyance
- Light Distribution is a major factor in **aesthetics**
  - Shaping and enhancing the architectural environment



# Distribution & Glare Requirements Considerations

- The DLC seeks light distribution and glare requirements that:
  - Align with industry standards, practices and guidelines
  - Minimize testing burden and implementation complexity
  - Distinguish products that meet a minimum acceptable level of performance
  - Ensure lighting quality for products with high energy performance
  - Acknowledge potential tradeoffs between energy performance and superior quality for specific (low-glare) applications



# Distribution and Glare: Feedback and Changes

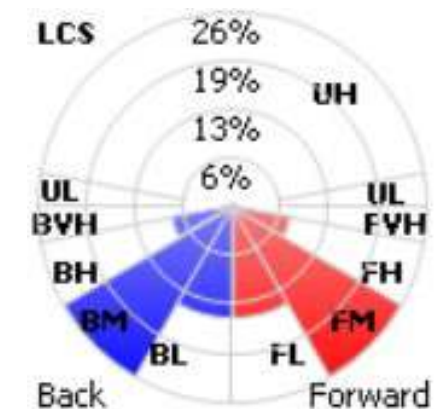
- Testing burden dialed back
  - **Simplified** and **combined** light distribution and glare requirements into one section
  - **Removed** additional reporting of distribution plots, beam angles and field angles
  - **Allowed** reporting of “rated” values for ZLD, SC and BUG for child products
- Scope of new metrics reduced
  - **Removed** glare control (unified glare rating, UGR) requirements for Standard products
  - **Limited** UGR requirements for Premium classification and efficacy allowances
  - **Eliminated** UGR listing on the QPL

# Draft 2: Distribution & Glare Requirements

Metric and/or Data set	Current V4.4 Requirement	V5.0 Draft Requirements			Method of Evaluation
		Threshold	Reported	QPL Listing	
<b>Zonal Lumen Distributions (ZLD) &amp; Spacing Criteria (SC)</b>	Specific Requirements for each PUD	Identical to V4.4	ZLD & SC for each product	<b>Single &amp; Family Parent:</b> ZLD & SC from LM-79 test reports listed as "Tested Data" <b>Family Child:</b> ZLD & SC reported by the manufacturers and listed as "Reported Data"	Values produced by photometric analysis from tested .ies files

## Distribution:

- ZLD & SC threshold stays the same as V4.4 but listing for all products (Tested & Reported)
- ZLD & SC for child products are reported and listed based on manufacturer's own calculation

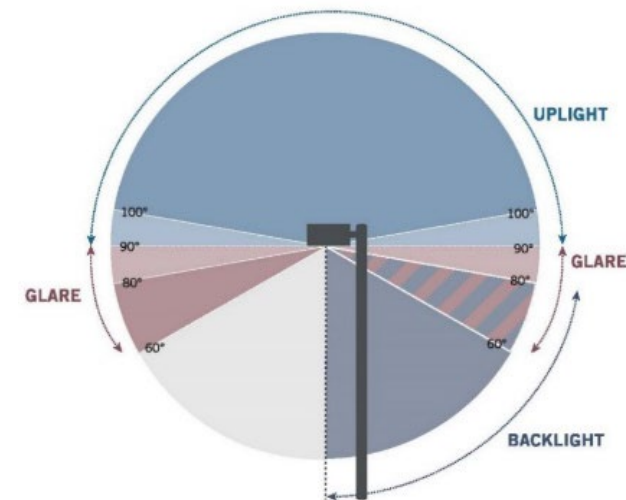


# Draft 2: Distribution & Glare Requirements

Metric and/or Data set	Current V4.4 Requirement	V5.0 Draft Requirements			Method of Evaluation
		Threshold	Reported	QPL Listing	
<b>Backlight, Uplight and Glare (BUG)</b>	None	None	BUG ratings for each product	<b>Single &amp; Family Parent:</b> BUG ratings generated using tested photometric data and listed as "Tested Data" <b>Family Child:</b> BUG ratings listed as "Reported Data"	BUG rating generated per <a href="#">IES TM-15-11</a> and <a href="#">Addendum A for IES TM-15-11</a> using luminaire photometric data

## BUG (Backlight, Uplight and Glare):

- For outdoor luminaires and outdoor retrofit kits only
- Reporting of B, U, and G ratings, e.g. **B2 U0 G2** (based on lumen output within predefined solid angles)
- BUG ratings for child products are reported and listed based on manufacturer's own calculation methods



# Draft 2: Distribution & Glare Requirements

Metric and/or Data set	Current V4.4 Requirement	V5.0 Draft Requirements			Method of Evaluation
		Threshold	Reported	QPL Listing	
<b>Glare</b>	None	Standard: None  Premium & Allowances: dependent on General Applications	Standard: N/A  Premium & Allowances: Manufacturers indicate UGR bin	Not listed	UGR tables as per <a href="#">CIE 117-1995</a> <a href="#">CIE 190-2010</a>

## Unified Glare Rating (UGR):

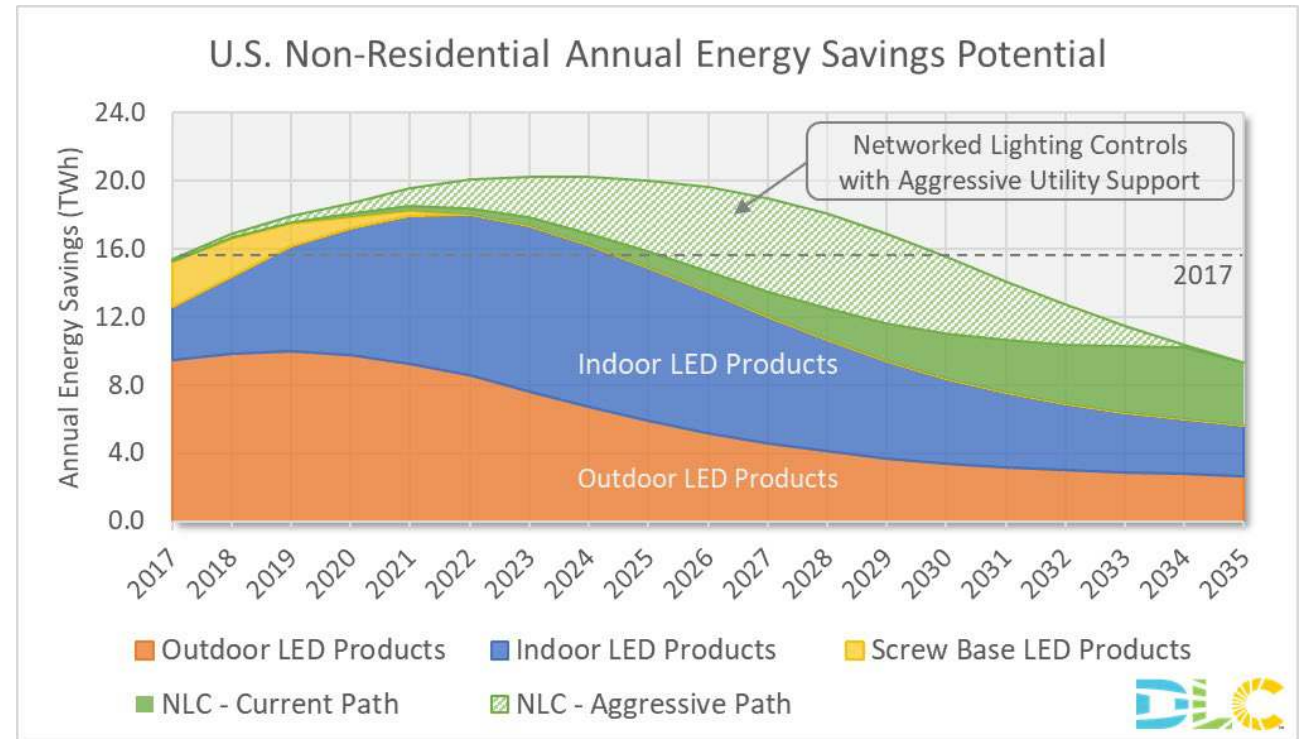
- No UGR reporting for Standard products
- No UGR values published on QPL
- UGR threshold for superior glare control to unlock efficacy allowances
- UGR threshold for acceptable glare control to achieve Premium

UGR	Applications
10	<i>Imperceptible</i>
13	<i>Just perceptible</i>
16	Technical drawing
19	Typical office/ computer tasks
22	Craft & light industry
25	Heavy industry
28	<i>Uncomfortable</i>

# Controllability

# Controllability Rationale

- Increase the controls functionality qualified products
- Encourage greater adoption of controls
  - Minimize installation of uncontrolled products
- Enable increased energy savings with more user satisfaction
- Aid product specification by providing more information about product controllability



# Controllability Requirements Considerations

- Minimize additional testing burden & implementation complexity
- Build upon existing V4.4 controllability requirements
- Expand controllability information on QPL while limiting impact to product listings
- Introduce controllability requirements within product categories that are likely to provide benefits to customers
- Collect reported information that can support alignment across SSL and NLC QPLs

# Controllability: Feedback and Changes

- Feedback
  - A dimming requirement for outdoor and lamp General Applications would add product cost and complexity for a capability that may not be needed in many applications
  - Need details for integral control options and implementation plan
- Draft 2 Updates
  - Dimming requirement will not apply to outdoor luminaires and lamps
  - Integral control reporting options defined
  - Added communication type to controls compatibility



# Draft Testing and Reporting Requirements – Dimming

Metric	V4.4 Requirements	Draft V5.0 Requirements	QPL Listing	Method of Evaluation
<b>Dimming</b>	Required reporting of dimming capability for all products	<i>Indoor luminaires and retrofit kits, excluding case lighting and specialty hazardous:</i> Continuous dimming capability required.	1. Dimming capability: continuous, step, none	Product specification sheet must clearly identify dimming capability and range of continuous dimming (if applicable)
		<i>All other products:</i> Required reporting of dimming capability.	2. Range of continuous dimming (if applicable)	

New in draft 2: dimming performance requirement does not apply to outdoor and lamps

# Draft Testing and Reporting Requirements – Integral Controls

Metric	V4.4 Requirements	Draft V5.0 Requirements	QPL Listing	Method of Evaluation
<b>Integral Controls</b>	Optional reporting integral controls of capability (Yes/No); required Reporting required for Premium.	All products are required to report integral control capability. Products with integral controls must provide additional detail regarding the type of controls.	<ol style="list-style-type: none"> <li>Integral control capability: yes, no</li> <li>Type of integral controls * (if applicable)</li> </ol>	Product specification sheet must clearly identify the types of integral controls available.
		<p>* Options include: Occupancy/Vacancy Sensing, Daylight Sensing, Multifunction Sensing (Occupancy + Daylight), High-end Trim, LLLC, Energy Monitoring, Traffic Sensing, Exterior Photocell, Networked Replacement Lamp  <i>Multiple selections are permitted</i></p>		

New in draft 2: types of integral control options defined and method of evaluation specified

# Integral Control Type Definitions

Select types of integral controls shown below. All types are defined in V5.0 Draft 2 (Table 10)

Integral Control Types	Definition	Acceptable Terms on the Product Spec Sheet
LLLC	The capability to have a networked occupancy sensor, ambient light sensor, and high-end trim installed for each luminaire/kit/lamp, and directly integrated or embedded into the form factor during the manufacturing process.	Integrated/embedded networked lighting control, luminaire-level lighting control, LLLC. The LLLC must be a DLC qualified system and the system name must be shown on the product specification sheet.
Energy Monitoring	The capability of a system to report the energy consumption of a luminaire/lamp	Power/Energy Monitoring, Power/Energy Metering, Power/Energy Measurement.
Networked Replacement Lamp	A linear, mogul screw-base, or four pin-base replacement lamp that includes <u>all</u> the following controllability features built into the lamp: continuous dimming; wireless communication; high-end trim; and individual addressability. Some networked replacement lamps may also incorporate integrated sensors such as occupancy/vacancy sensing.	Networked, Smart, Intelligent, Connected, Advanced, NLC

# Draft Testing and Reporting Requirements – Controls Compatibility

Metric	V4.4 Requirements	Draft V5.0 Requirements	QPL Listing	Method of Evaluation
<b>Controls Compatibility</b>	None	All products listed as dimmable are required to report the control signal communication type and dimming protocol.	1. Communication type: wired, wireless, none  2. Dimming protocol ** (for continuously dimmable products)	Product specification sheet must clearly identify the communication type and dimming protocol (if applicable)
		** Wired options include: 0-10V, DALI, DMX, Power Signal / Phase-cut, Proprietary, Other Wired ** Wireless options include: Zigbee, Bluetooth, WiFi, Proprietary, Other Wireless <i>Multiple selections are permitted</i>		

New in draft 2: communication type included, dimming protocol options defined, method of evaluation specified

# DLC Premium

# V5.0 DLC Premium Rationale

Promote products that **achieve higher energy savings while delivering quality of light and controllability performance** that exceeds DLC standard requirements

- Encourage higher levels of efficacy *without sacrificing quality of light performance*
- Gain better confidence in the glare performance of DLC Premium products



# V5.0 Premium Requirements Considerations

- Build upon existing DLC Premium structure and branding
- Incorporate a balanced mix of energy, quality, and controllability requirements
- Allow Premium qualification for Luminaires\* and Retrofit Kits\*\*
- Minimize additional testing burden & implementation complexity
- Align methods of evaluation with DLC Standard (where applicable)

\* Excluding luminaire products with a Primary Use designated as "Specialty"

\*\* Excluding Retrofit Kits for Direct Linear Ambient Luminaires and Linear-Style Retrofit Kits for 2x2, 1x4, and 2x4 luminaires

# DLC Premium in ~~V4.4~~ V5.0

- Premium performance designation for luminaires and retrofit kits
  - Higher efficacy (+15 point delta vs. Standard)
  - Continuous dimming required
  - More strict color consistency and maintenance
  - Minimum glare performance for select PUDs
  - ~~Must provide information about integral controls~~ (required for all products)
  - Improved lumen maintenance ( $L_{90} > 36,000$  hours)
  - Driver ISTMT



# V5.0 DLC Premium Key Requirements

Metric	Current V4.4 Premium Requirements	V5.0 Draft Premium Requirement	
<b>Efficacy</b>	Premium efficacy requirements vary by General Application. The product-weighted average is +22 lumens per watt over V4.4 Standard efficacy.	<b>+15 lumens per watt</b> over V5.0 Standard efficacy requirements.	
<b>Glare</b>	None	Troffers and Linear Ambient *	Minimum performance requirement <b>UGR &lt; 19</b> **
		Low-Bay	Minimum performance requirement <b>UGR &lt; 22</b> **
		High-Bay	Minimum performance requirement <b>UGR &lt; 25</b> **

\* Linear-style retrofit kits and retrofit kits for direct linear ambient are not eligible

\*\* UGR values will not be published on QPL

# DLC Premium Efficacy V4.4 vs. V5.0

General Application	V4.4 Premium	V5.0 Premium	Change vs. V4.4
Indoor: Troffer	125	125	0
Indoor: Linear Ambient	130	130	0
Indoor: Low-Bay	130	130	0
Indoor: High-Bay	130	135	+5
Indoor: Case Lighting	125	110	-15
Indoor: Interior Directional	90	95	+5
Outdoor: Low Output	110	120	+10
Outdoor: Mid Output	115	120	+5
Outdoor: High Output	120	120	0
Outdoor: Very High Output	120	120	0

Glare performance requirements apply

+ 15 lpW over V5.0 Standard

# V5.0 DLC Premium Key Requirements

Metric	Current V4.4 Premium Requirements	V5.0 Draft Premium Requirement	
<b>Controllability</b>	Products are required to report integral controls capability	All products must be <b>capable of continuous dimming.</b> (note: integral control reporting is required for all products at DLC standard level)	
<b>Chromaticity (CCT &amp; Duv)</b>	None	Indoor ( <i>except High-Bay</i> )	<b>4-step ANSI quadrangle</b> CCTs 2200 K – 6500 K
<b>Color Maintenance</b>	None	Indoor ( <i>except High-Bay</i> )	Chromaticity shift (1000-hours to 6000-hours) within a distance of $\Delta u'v' \leq 0.002$ (CIE 1976)
		Outdoor + High-Bay	Chromaticity shift (1000-hours to 6000-hours) within a distance of $\Delta u'v' \leq 0.004$ (CIE 1976)

# V5.0 DLC Premium Key Requirements

Metric	Current V4.4 Premium Requirements	V5.0 Draft Premium Requirement
<b>Driver ISTMT</b>	TMPps $\leq$ driver operating temp specification	No change
<b>Lumen Maintenance</b>	L90 > 36,000 hours, as evaluated using TM-21*	No change

\* New LM-80 / TM-21 reporting guidelines apply

# **Additional Reporting Guidelines**

# Additional Reporting Guidelines

- V5.0 requires **complete information** be included in LM-79 test reports that may not have been required in the past
- Also proposes new compliance requirements related to **TM-21 and its Addendum B**



# IES LM-79 (-08 and -19 versions)

- Color-specific test reports are referred to in V5.0 as “**full LM-79/color reports**” include:
  - Electrical characteristics (Wattage, input voltage)
  - Total luminous flux
  - Efficacy
  - Chromaticity (( $x,y$ ), ( $u,v$ ) and ( $u',v'$ ))
  - CCT and Duv
  - ANSI/IES TM-30-18 Full Report and CIE 13.3-1995 complete CRI detail
  - Accompanying .SPDX document (IES TM-27) with spectral power distribution data from 380-780 nm in 1nm increments

# IES LM-79 (-08 and -19 versions)

- Distribution-specific test reports are referred to in V5.0 as “**full LM-79/distribution reports**” include:
  - Electrical characteristics (Wattage, input voltage)
  - Luminous intensity distribution (Candela array)
  - .ies file (ANSI/IES LM-63-02(R2008)) using Type C photometry with luminous intensity distribution data in a resolution of 5 degree or less vertical and 15 degree or less for horizontal planes.
    - The width, length and height fields in the .ies file must pertinently reflect the luminous dimensions of the product’s luminous opening



# IES TM-21-11 and its Addendum B

- Long term lumen maintenance projections will be accepted only if fully compliant with **TM-21-11 and its Addendum B**.  
Includes:
  - Luminous flux data collection and selection (section 4.3)
  - Data used for the curve-fit (section 5.2.3)
  - Temperature data interpolation (section 6.0)
  - Limit for Extrapolation (section 6.5)
- A complete and accurate copy of [the June 18, 2018 version of the ENERGY STAR TM-21 calculator](#) will be required for submission, and will suffice in meeting the requirements

# Allowances and Tolerances

# Allowances - Color

Feature	General Application	Performance Metric	Allowance under V4.4	Allowance under V5.0
CCT	All	$\leq 3000\text{K}$	-3%	n/a
	All	$\leq 2700\text{K}$	-5%	-5%
Color Rendition	Indoor, excluding high-bay	ANSI/IES TM-30-18: <ul style="list-style-type: none"> <li>IES <math>R_f \geq 75</math>; IES <math>R_g \geq 92</math></li> <li><math>-7\% \leq \text{IES } R_{cs,h1} \leq +19\%</math></li> </ul>	-5%	-5%
		CIE 13.3-1995: <ul style="list-style-type: none"> <li><math>R_a \geq 90</math> and <math>R_g \geq 50</math></li> </ul>		
	Outdoor and high-bay	ANSI/IES TM-30-18: <ul style="list-style-type: none"> <li>IES <math>R_f \geq 78</math>; IES <math>R_g \geq 95</math></li> <li><math>-1\% \leq \text{IES } R_{cs,h1} \leq +15\%</math></li> </ul>	n/a	-10%
		ANSI/IES TM-30-18: <ul style="list-style-type: none"> <li>IES <math>R_f \geq 70</math>; IES <math>R_g \geq 89</math></li> <li><math>-12\% \leq \text{IES } R_{cs,h1} \leq +23\%</math></li> </ul> CIE 13.3-1995: <ul style="list-style-type: none"> <li><math>R_a \geq 80</math> and <math>R_g \geq 0</math></li> </ul>	n/a	-5%

# Allowances - Glare

Feature	General Application	Performance Metric	Allowance under V4.4	Allowance under V5.0
Glare	Troffers & Linear Ambient	UGR < 16 at the glare evaluation reference condition of <ul style="list-style-type: none"> <li>Room dimension: X = 4H, Y = 8H</li> <li>Spacing to height ratio (S/H): 1</li> <li>Reflectances: 70/50/20%</li> </ul>	n/a	-10%
	Low-Bay	UGR < 19 at the glare evaluation reference condition of <ul style="list-style-type: none"> <li>Room dimension: X = 4H, Y = 8H</li> <li>Spacing to height ratio (S/H): 1</li> <li>Reflectances: 70/50/20%</li> </ul>	n/a	-10%
	High-Bay	UGR < 22 at the glare evaluation reference condition of <ul style="list-style-type: none"> <li>Room dimension: X = 4H, Y = 8H</li> <li>Spacing to height ratio (S/H): 1</li> <li>Reflectances: 70/50/20%</li> </ul>	n/a	-10%

# Maximum Allowance

- **15% Maximum Allowance**

- Allows a product with true high quality of light to get some portion of each allowance type available

- E.g. a troffer that has:

- CCT of 2700K (5%)

- $R_a \geq 90$  and  $R_g \geq 50$  (5%)

- $UGR < 16$  (10%)

- Could claim 15% (effectively 5% from each Quality of Light criterion)

# Tolerances

- **New metrics** in V5.0 may use tolerances:
  - Color Rendering
  - Color Maintenance
  - UGR
- **Existing tolerances** are still in place:
  - Light Output
  - Efficacy
  - CCT

# Tolerances

Performance Metric	V4.4 Tolerance	V5.0 Tolerance
Light Output	±10%	±10%
Luminaire Efficacy	-3%	-3%
Allowable CCT	Defined by ANSI C78.377-2015	Defined by ANSI C78.377-2017
Minimum Color Rendering	-2 points Ra	All reported color rendition metrics, except IES $R_{cs,h1}$ : -1 point IES $R_{cs,h1}$ : -1 percent
Color Maintenance	n/a	Data must be collected within a ±48 hour window of both the "1000 hour measurement point" and the "6000 hour measurement point", with a $\Delta t \geq 5000$ hours.
UGR	n/a	+1.0
<del>Power Factor</del>	<del>-3%</del>	<del>n/a</del>
<del>Total Harmonic Distortion</del>	<del>+5%</del>	<del>n/a</del>

# **Total Harmonic Distortion and Power Factor**



# THD and PF

- In order to balance new V5.0 requirements with testing burden, we are proposing to remove THD and PF requirements
  - Since first collecting THD and PF (2012), data have been consistent
  - Surveillance over the last 28 months, only 0.01% and 0.02% of products have failed from THD and PF, respectively
  - As such, removing these requirements is a safe tradeoff in asking for more testing around the quality of light

Metric	Current V4.4 Requirements	Draft V5.0 Requirement	Method of Evaluation
THD	$\leq 20\%$	none	n/a
PF	$\geq 0.9$	none	n/a

# Reference Housings

# Background/Feedback

- For all retrofit kit and lamp categories, DLC requires testing of the kit or lamp in a “typical reference housing”
  - Some categories requiring testing in the housing only; others require testing of the bare lamp AND testing in a reference housing
- For each category, a number of specific housings are allowed for testing. There are also provisions for pre-approved equivalents, and for kits designed only and exclusively for specific luminaires/housings.

Process Too Burdensome

TLED Performance Well Established

Too Much Variability

Some Housings Not Available

# Linear Replacement Lamps (TLEDs and 2G11-base CFLs)

- Reference Housing Requirement **Replaced with:**
  - ISTMT conducted in appropriate thermal environment per safety certification
  - Distribution Requirement validated for each optical variation at highest light output with Goniometer testing (IES files)

Table 15: Linear Replacement Lamp Technical Requirements

TLED General Application	Initial Light Output	Bare-lamp Efficacy	Bare-lamp Beam Angle*
Two-foot Lamps, T8 Replacements	≥ 800 lm	≥ 120 lm/W	≥ 160°
Three-foot Lamps, T8 Replacements	≥ 1,200 lm	≥ 120 lm/W	≥ 160°
Four-foot Lamps, T8 Replacements	≥ 1,600 lm	≥ 120 lm/W	≥ 160°
Four-foot Lamps, T5 Replacements	≥ 1,600 lm	≥ 120 lm/W	≥ 160°
Four-foot Lamps, T5HO Replacements	≥ 3,200 lm	≥ 120 lm/W	≥ 160°
Eight-foot Lamps, T8 Replacements	≥ 3,200 lm	≥ 120 lm/W	≥ 160°
U-bend Lamps, T8 Replacements	≥ 1,400 lm	≥ 120 lm/W	≥ 160°
2G11 Replacement Lamps	≥ 1,900 lm	≥ 120 lm/W	≥ 160°

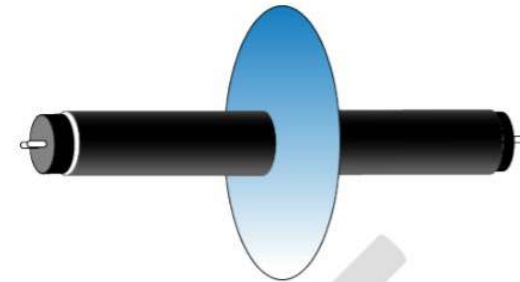


Figure 1: TLED Beam Angle Definition

- **\*Beam Angle** – the angle between the two opposite directions in which the average intensity is 50% of the center beam intensity as measured in the azimuthal plane perpendicular to and at the center of the TLED lamp axis.

# Other Lamp Categories

*(Retrofit Kits, MogLEDs, and Four Pin-Base Replacement Lamps for CFLs)*

- **NO CHANGE to current Reference Housing Requirement**

- Testing to be conducted on a single reference housing based on PUD

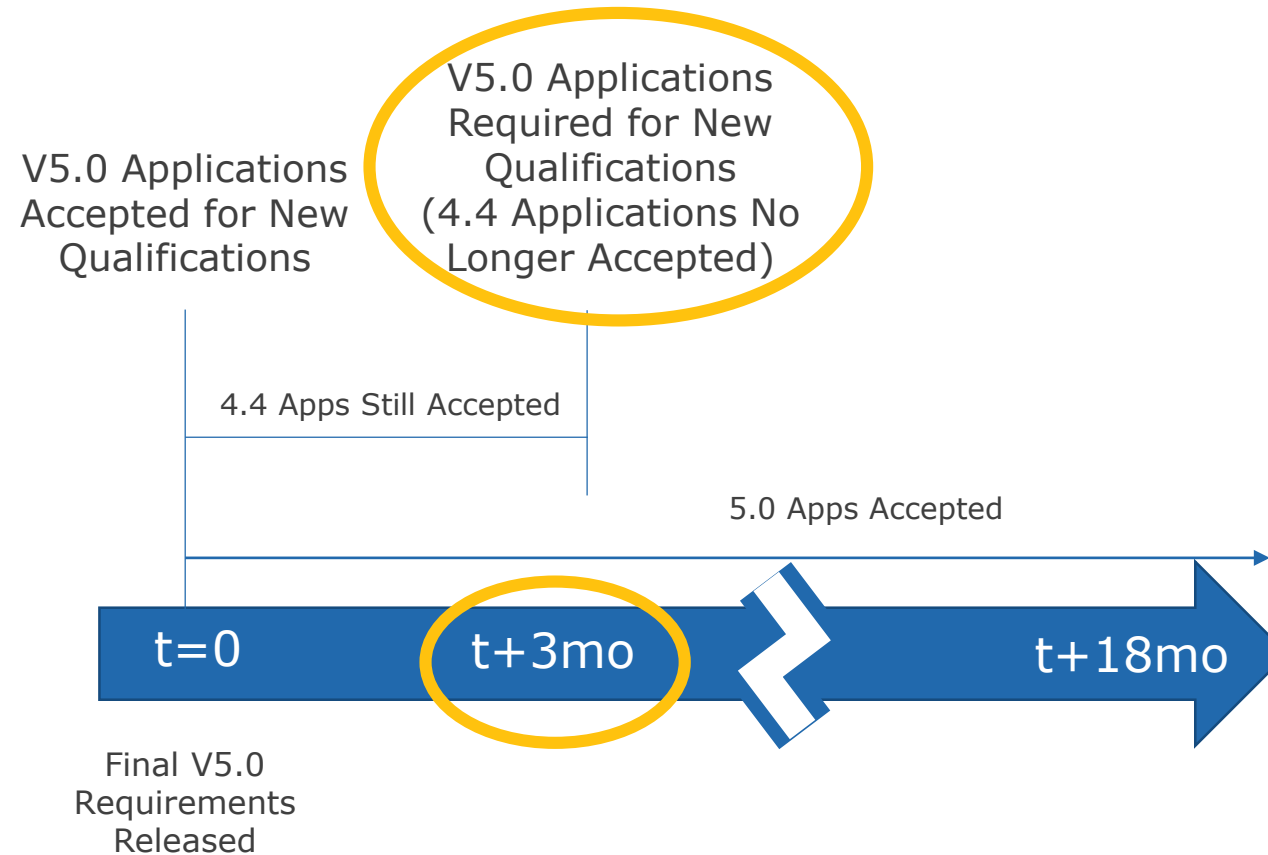
- Simplifies policy and specifies a commonly used and readily available housings based on PUD

Category/Primary Use	Reference Housing
Retrofit Kits for Pole/Arm-Mounted Area and Roadway Luminaires; Mogul-screw base (E39) Replacement Lamps for Pole/Arm-Mounted Area and Roadway Luminaires	GE M250R2
Retrofit Kits for Large Pole/Arm-Mounted Area and Roadway Luminaires	GE M400R2
Retrofit Kits for Decorative Area Luminaires; Mogul-screw base (E39) Replacement Lamps for Decorative Area Luminaires	King Luminaire K400 Series
Retrofit Kits for Full-Cutoff Wall-Mounted Area Luminaires	Lithonia TWF1 100S
Mogul Screw-base (E39) Replacement Lamps for Full-Cutoff Wall-Mounted Area Luminaires	Lithonia TWF2
Retrofit Kits for Parking Garage Luminaires; Mogul-screw base (E39) Replacement Lamps for Parking Garage Luminaires	Lithonia KACM Series Fixture
Retrofit Kits for Fuel Pump Canopy Luminaires; Mogul-screw base (E39) Replacement Lamps for Fuel Pump Canopy Luminaires	LSI Scottsdale Series Fixture
Retrofit Kits for 2x2 Luminaires; 2G11-base CFLs	Lithonia 2GT8 lensed 2X2
Retrofit Kits for 1x4 Luminaires	Lithonia GT8 lensed 1X4
Retrofit Kits for 2x4 Luminaires	Lithonia 2GT8 lensed 2X4
Retrofit Kits for Direct Linear Ambient Luminaires	Lithonia C2 32 MVOLT GEB10IS
Retrofit Kits for High-bay Luminaires; Mogul-screw base (E39) Replacement Lamps for High-Bay Luminaires	Lithonia THD 400S A15 TB (HID-style) Lithonia MS5HB (Fluorescent-style)
Retrofit Kits for Low-bay Luminaires; Mogul-screw base (E39) Replacement Lamps for Low-Bay Luminaires	Lithonia TGR 175MP A125 TB SCWA (HID-style) Lithonia L Series (Fluorescent-style)
G24q/GX24q CFL Replacement Lamps	Prescolite LF6CFH 218 EB LCFH WT (horizontally-mounted) Prescolite LF6CFV 32 EB LCFHV WT (vertically-mounted)



# Implementation

# New Product Qualification Applications Submitted After Release of V5.0



# Transition Options for Manufacturer

## One-Step Transition:

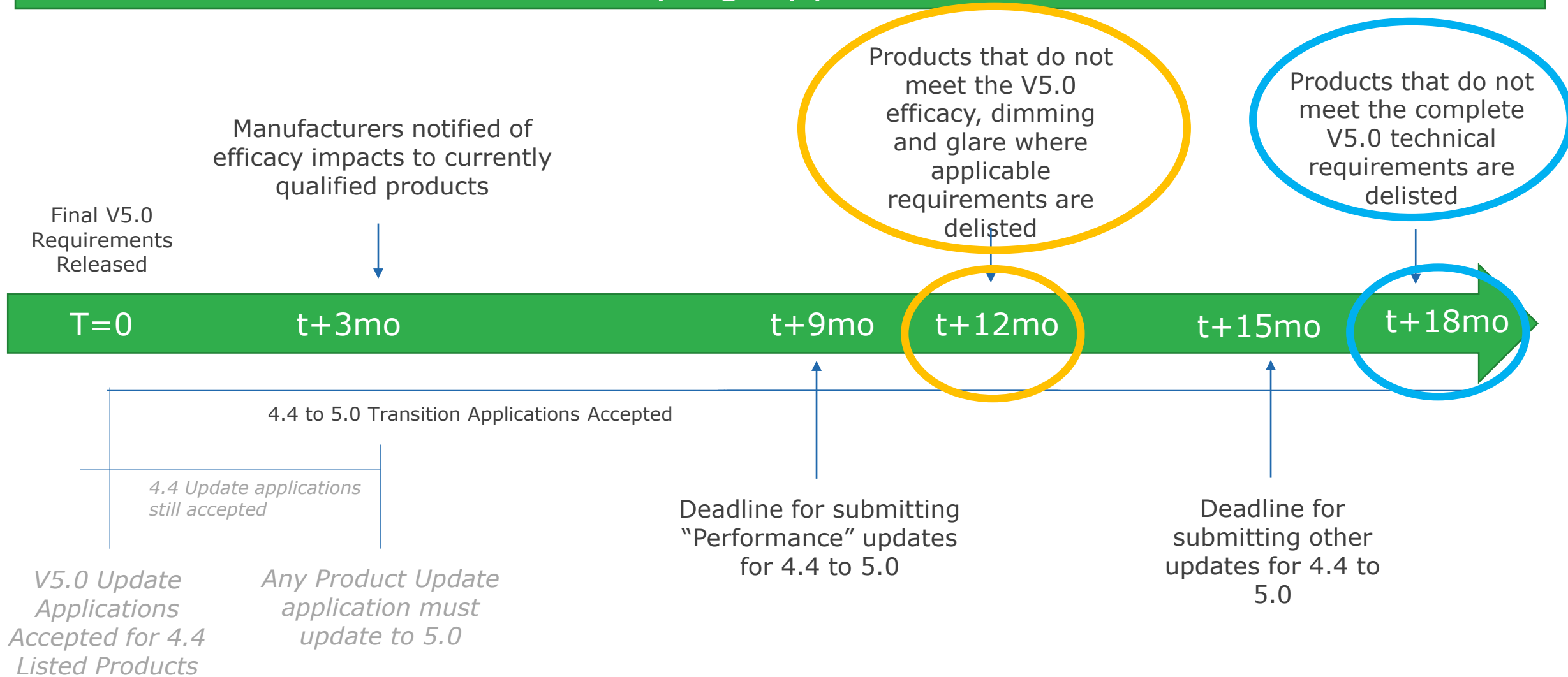
1. Submit a complete update application for all listed products that includes any changes and new information related to efficacy impacts as well as all other required v5.0 data for each listing.

## Two-Step Transition:

1. an update application submitted first for all products impacted by **efficacy, dimming and glare** (where applicable), **without the rest of the 5.0 data.**
  - Efficacy updates for premium products (and any allowance requests) would be subject to V5.0 glare requirements.
  - Any changes to dimming are also required with the first 12 month grace period.
2. A separate follow-on application submitted for all listed products that includes all of the other required information for 5.0.



# Updating Products Originally Submitted Through Standard or Family Grouping Applications



# Next Steps

# Important Dates

## SSL V5.0

9/30/19  
Draft 2

11/8/19  
Comments  
Due

January 2020  
Final Release

April 2020  
V5.0 Apps  
Required

*Dates subject to change*

# Question & Answer

30 minutes



# Thank You!

Please send questions and comments to:  
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