

2019



April 1 - 3 • St. Louis, MO

STAKEHOLDER MEETING



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Discussion Session:
Color and Spectral Quality



Technical Team:



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Session Objectives:

- Review draft Color quality and Circadian wellness requirements
- Summarize comments received into main themes
- Discuss remaining feedback and ways to address main themes

Desired Outcome:

- Actionable feedback to inform Draft 2



WHO'S HERE?



Agenda:

- | | |
|--|---------|
| ▪ Expectations / Ground Rules | 5 mins |
| ▪ Color Quality Requirements Overview | 15 mins |
| ▪ Circadian Wellness Requirements Overview | 10 mins |
| ▪ Comment Themes | 15 mins |
| ▪ Discussion Break-Outs | 30 mins |
| ▪ Report Outs | 15 mins |



DO'S

- ✓ Share your perspective
- ✓ Ask Questions!
- ✓ Respect Other's Views
- ✓ Stay On Topic



DON'TS

- ✗ Soapbox
- ✗ Talk Over Others
- ✗ Argue Semantics
- ✗ Throw Tomatoes





Spectral Quality Overview



Color Quality

- Color quality:
 - directly influences **task performance**
 - is related to occupant **safety**
 - is a major factor in **aesthetics**
 - is important for **comfort** and **wellbeing**





Draft Requirements Color Rendering

Metric	Current V4.4 Requirements	V5.0 Draft Requirements		Method of Evaluation
		Tier 1	Tier 2	
Color Rendering (of objects)	CRI (CIE 13.3-1995): <ul style="list-style-type: none"> • $R_a \geq 80$ (indoor) • $R_a \geq 65$ (outdoor) • $R_a \geq 70$ (high bay) 	ANSI/IES TM-30-18: <ul style="list-style-type: none"> • $IES R_f \geq 78$ • $IES R_g \geq 95$ • $-1\% \leq IES R_{cs,h1} \leq +15\%$ CIE 13.3-1995: <ul style="list-style-type: none"> • $R_a \geq 90$ and $R_9 \geq 50$ 	ANSI/IES TM-30-18: <ul style="list-style-type: none"> • $IES R_f \geq 70$ • $IES R_g \geq 89$ • $-12\% \leq IES R_{cs,h1} \leq +23\%$ CIE 13.3-1995: <ul style="list-style-type: none"> • $R_a \geq 80$ and $R_9 \geq 0$ 	IES LM-79-08 ANSI C78.377-2017 (ANSI/IES TM-30-18 Full Report and CIE 13.3-1995 complete CRI Detail)

Summary:

- Two tiers of requirements
- Qualification path for TM-30 or CRI
- Both TM-30 and CRI to be reported



Source: Don Slater, NightTime Design

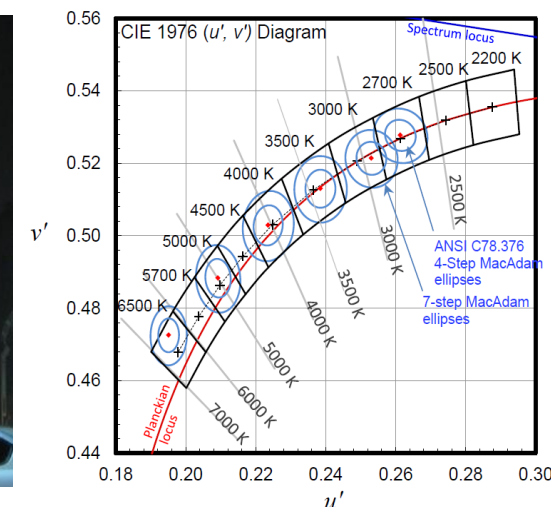
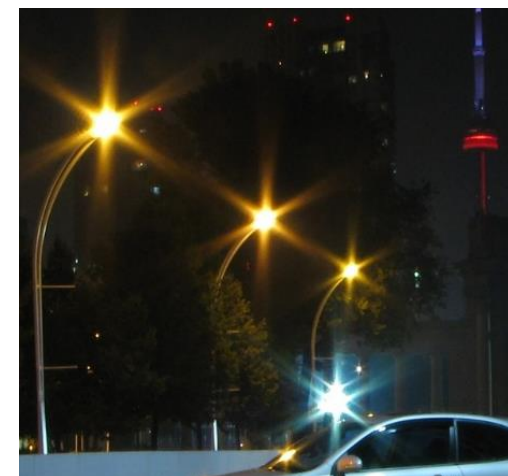


Draft Requirements Color of Light (Chromaticity, D_{uv} , CCT)

Metric	Current V4.4 Requirements	V5.0 Draft Requirements		Method of Evaluation
		Tier 1	Tier 2	
Color of Light Chromaticity (CCT & D_{uv})	7-step ANSI quadrangle CCTs ≤ 5000 K (indoor) CCT ≤ 5700 K (outdoor & high bay)	4-step ANSI quadrangle CCTs 2200 K – 6500 K	7-step quadrangle CCTs 2200 K – 6500 K	IES LM-79-08 ANSI C78.377-2017

Summary:

- Two tiers of requirements
- Expanding CCT definitions to 2200 – 6500 K



Source: ANSI C78.377-2017

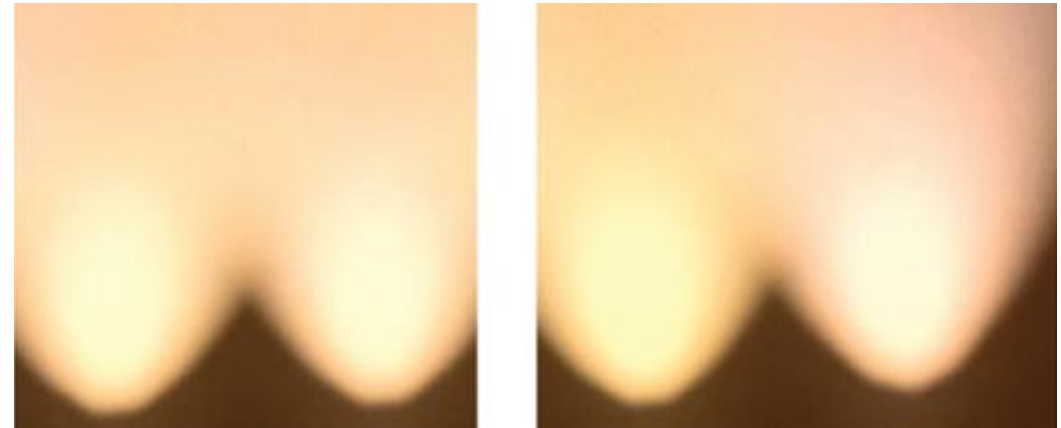


Draft Requirements Color Maintenance

Metric	Current V4.4 Requirements	V5.0 Draft Requirements		Method of Evaluation
		Tier 1	Tier 2	
Color Maintenance	n/a	Chromaticity shift (0-hour to ≥ 6000 hours) within a distance of $\Delta u'v' \leq 0.002$ (CIE 1976)	Chromaticity shift (0-hour to ≥ 6000 hours) within a distance of $\Delta u'v' \leq 0.004$ (CIE 1976)	ANSI IES LM-80-15 and/or IES LM-84-14

Summary:

- Two tiers of requirements
- Chromaticity shift at ≥ 6000 hours



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



Draft Requirements

Metric	Current V4.4 Requirements	V5.0 Draft Requirements		Method of Evaluation
		Tier 1	Tier 2	
Consistency (of chromaticity)	n/a	Chromaticity of 3 tested samples shall fall within a circle of diameter of 0.003 (CIE 1976)	Chromaticity of 3 tested samples shall fall within a circle of diameter of 0.006 (CIE 1976)	IES LM-79-08 ANSI C78.377-2017
Angular Color Uniformity	n/a	Optional reporting: Chromaticity variance ($\Delta u'v'$) throughout the beam and/or field angle (resolution: 1° on the 0° and 90° vertical planes)		IES LM-79-08

Summary: Color Consistency

- Two tiers of requirements
- Three product units shall provide close to the same chromaticity

Summary: Angular Color Uniformity

- Optional reporting for manufacturers to enable differentiation
- Relevant only for certain PUDs



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



Alertness, Sleep and Circadian Wellbeing

- Encourage lighting products that support human wellbeing
- Provide information on a lighting product's spectral properties around 460-520 nanometers:
 - (Daytime) Alertness
 - Circadian Wellbeing (lighting to support daily rhythms)
- Enable product differentiation to meet needs of applications with specific demands on human performance and wellbeing
 - (e.g. work environments, health care, educational facilities)



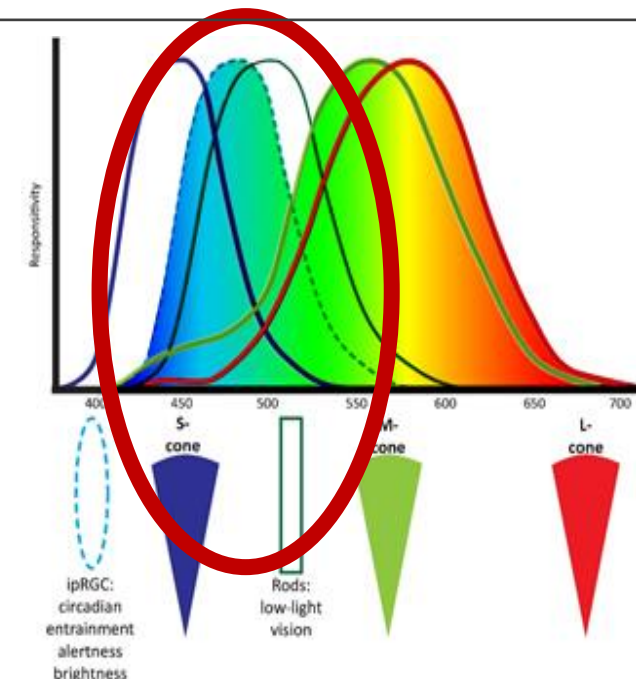
Draft Requirements Alertness, Sleep and Circadian Wellbeing

Metric	Current V4.4 Requirements	V5.0 Draft Requirements	Method of Evaluation
Melanopic Flux	n/a	Required to report	As per CIE S 026/E:2018
M/P Ratio	n/a	Required to report	As per Lucas et al., 2014, and WELL™ v2, Appendix L1
Melanopic Daylight (D65) Efficacy Ratio	n/a	Required to report	As per CIE S 026/E:2018

Summary:

Reporting information for spectral properties around 460-520 nm

- Melanopic Flux
- Melanopic/Photopic Ratio (M/P Ratio)
- Melanopic Daylight Efficacy Ratio





Spectral data processing

Color Rendering	Color of Light	Circadian Wellness
<ul style="list-style-type: none"> • TM-30 metrics • CRI metrics 	<ul style="list-style-type: none"> • Chromaticity • Duv • CCT 	<ul style="list-style-type: none"> • Melanopic Flux • Melanopic/Photopic Ratio • Melanopic Daylight Efficacy Ratio



Spectral data **(SPD)** based on Spectrophotometer/sphere testing



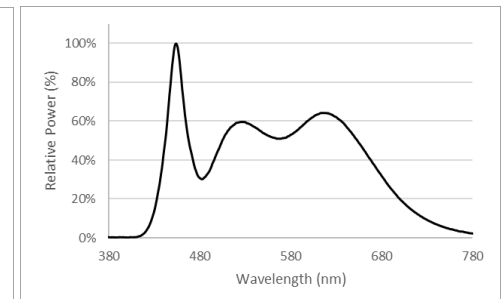
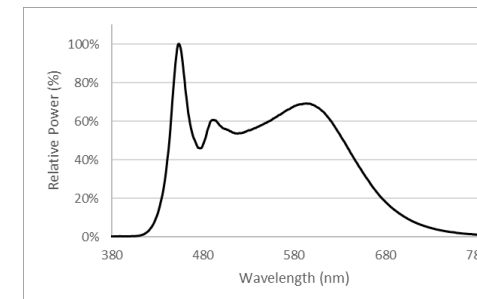
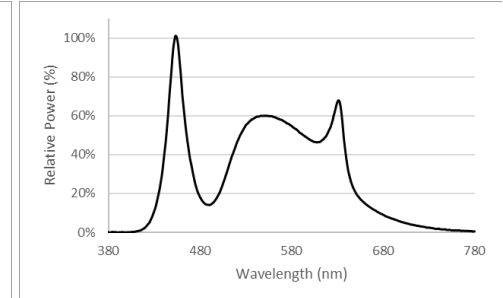
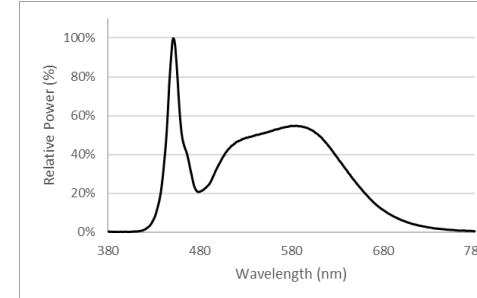
Draft Requirements Spectral Quality

Metric	Current V4.4 Requirements	V5.0 Draft Requirements		Method of Evaluation
		Tier 1	Tier 2	
Spectral Power Distribution (SPD)	n/a	Spectral range of 380 – 780 nm at 1 nm increments must be reported.		IES LM-79-08 (per IES TM-27-14 and/or ANSI IES TM-33-18)

Summary:

Reporting of the SPD

- Enabling calculation of other (future) metrics
- Use with calculators and tools to estimate lighting impact in application
- Use with metrics still in development
- Enable auto-generation





Clarifying Questions?

We'll get to the technical issues shortly...



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- | | |
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Comment Themes



Theme 1: Both support and concerns for using .spdx files to generate metrics

- Support for using .spdx files
 - Autogeneration of data would streamline the submission and update process
- Concerns for using .spdx files
 - **Consistency/Format** – How would DLC ensure consistency of data and reported format?
 - **Accuracy** – How to ensure files are accurate and up-to-date?
 - **Testing/Reporting Burden** – How to capture SPD data for each product without creating significant testing and reporting burden?
 - **Data Accessibility** – Should .spdx file data be accessible to QPL users?



Theme 2: Both support and concerns for using two tiers

- Support re: tiers
 - General support for the concept of baseline quality category and higher quality category to accommodate different application needs
- Concerns re: tiers
 - There are not enough tiers; needs for color and spectral quality vary by PUD and application; outdoor products require extra tiers
 - Tiers are suggesting a ranking where tier 1 is always better, but a product in tier 2 might be better suited for an application than a product in tier 1



Theme 3: Misunderstanding or misapplying color and circadian wellness metrics

- Support for using Metrics
 - Provides useful information using industry established methods and helps assure quality for QPL listed products
- Concerns for using Metrics
 - The proposed metrics have limitations that will not be understood by all QPL users
 - Circadian metrics would be misapplied thinking that a higher number is always better
 - Color rendering thresholds for TM-30 are not yet well understood
 - QPL users may misuse or misapply these metrics



Clarifying Questions?

If not, on to discussions...



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Discussion Session:

Step 1: Pick a Topic that is most relevant to you



Step 2: Move to that area of the room

Step 3: Further directions from the break-out facilitator



Discussion Break-Outs:

Topic 1 QPL Metrics Generation	Topic 2 QPL tiers	Topic 3 Preventing misapplication of metrics
<ul style="list-style-type: none"> • What are methods to generate spd-data for every product that minimizes testing burden. What are the pitfalls of the method(s)? • How should the metric values be generated? • Who should generate the metric values? Testing laboratories? Manufacturers? DLC? 	<ul style="list-style-type: none"> • Since spectral quality varies by application and product type, are two color quality tiers for indoor and outdoor product types enough, or are more needed? • Is it useful to report circadian wellness metrics for each category and/or product type? If not, which category and/or product type is it useful for? 	<ul style="list-style-type: none"> • Which metrics are prone to being misunderstood? • Are there suggestions for education, user tools, or strategies to prevent or mitigate the concern of misapplication? • Please be specific.



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Group Report Out Format

- | | | |
|----|--|--------|
| 1. | What Questions did you investigate? | 1 min |
| 2. | What are 2-3 <u>Key Take-Aways</u> for each? | 2 mins |
| 3. | What are the desired next steps? | 1 min |



Group Report Out

Topic 1

QPL Metrics Generation

Topic 2

QPL Listing Tiers

Topic 3

Preventing Misapplication
of Published Metrics



Group Report Out

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What did we miss?



Now What?

Shared Learning:

- Key findings will be shared with the conference audience today

More Feedback to share?:

- Find us to speak during the meeting or reach out

What's coming?

- Incoming information continues to inform development of V5.0 Drafts



Thank You!

Please feel free to find us throughout the conference

DesignLights Consortium[®]
www.designlights.org



Back-up info