



Light Usage for Night Applications (LUNA) Technical Requirements Version 1

Draft 1

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The DLC Light Usage for Night Applications (LUNA) Technical Requirements are designed to mitigate negative impacts of outdoor lighting at night. By establishing requirements and reporting standards on light distribution, spectral characteristics, and controllability, LUNA will identify energy efficient luminaires on the Solid-State Lighting (SSL) Qualified Products List (QPL) that also minimize light pollution, provide appropriate visibility for people, and limit negative impacts to the environment.

Goals of LUNA

The DLC LUNA program is intended to mitigate negative impacts of outdoor lighting at night by establishing system performance specifications and best practices with the following goals:

- **Minimize lighting energy use.** Baseline efficacy thresholds of DLC SSL V5.1 combined with additional dimming and control requirements ensure efficient use of lighting energy, which will help efficiency programs meet their savings goals and end users reduce operational costs. At the same time, because of the high priority of minimizing light pollution, LUNA provides allowances on energy efficiency in order to minimize light trespass with optical control.
- **Minimize light pollution.** New LUNA requirements for light distribution, spectral characteristics, and dimming control will decrease the light scattered into the atmosphere, so that light trespass and sky glow are reduced, resulting in darker skies and more controlled illumination to support wildlife, stargazers, and astronomers.
- **Provide appropriate visibility for people.** The DLC’s SSL V5.1 requirements for spectral quality, plus reporting of BUG rating, spectral power distribution, and intensity distribution, allow specifiers to choose the right product for the application so that installations meet recommended practices and voluntary guidelines.

The DLC LUNA Qualification and Logo

Products with the LUNA qualification (referred to as LUNA products) will be listed on the DLC Solid-State Lighting Qualified Products List. LUNA products can be either DLC Standard or DLC Premium, and will be eligible to use the DLC LUNA logo, which will be released with the final Technical Requirements. As with other DLC logos, all stakeholders must use the DLC logos and trademarks consistently and in compliance with [published guidelines](#) in all communication and marketing materials.

Eligibility

Only outdoor luminaires that fall into the Primary Use Designations (PUDs) listed in **Table 1** will be eligible for LUNA qualification under Version 1. At this time, lamps and retrofit kits will not be eligible for LUNA because their lighting distributions are highly dependent on application. Specialty designated

33 hazardous luminaires are eligible for LUNA and exempt from dimming requirements. Single product
 34 applications seeking LUNA qualification cannot include LUNA-ineligible variations.

35 Field-adjustable light distribution (FALD) products are not eligible for LUNA qualification, except for
 36 brackets that only allow vertical tilt angles up to 5 degrees, and except for luminaires utilizing house-side
 37 shielding (HSS) as [standard FALD components](#), as long as they meet the worst-case-efficacy
 38 requirements to receive an allowance. Field-adjustable light output (FALO) products are eligible for
 39 LUNA qualification, as long as the product is tested at the maximum light output setting.

40 Aimable luminaires, whether floodlights or area lighting with tiltable mounting brackets, may increase
 41 sky glow, discomfort glare, and light trespass, which are undesirable lighting qualities from both a light
 42 pollution perspective and for typical use cases. Therefore, floodlight-style PUDs and
 43 area/roadway/decorative PUDs with mounting brackets that allow tilt angles of more than +/- five
 44 degrees are not eligible for LUNA qualification.

45 **Table 1:** DLC SSL Primary Use Designations (PUDs) eligible for Version 1 LUNA qualification

Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
B	Outdoor Pole/Arm-Mounted Decorative Luminaires
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires
D	Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires
E	Bollards
F	Parking Garage Luminaires
G	Fuel Pump Canopy Luminaires
	Specialty: Hazardous Area Lighting
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires
	Specialty: Hazardous Wall Mounted Luminaire
	Specialty: Canopy Lighting
	Specialty: Directional Fuel Pump Canopy Luminaires
	Specialty: Transportation

46 Definitions

47 The following terms are used by the DLC in the LUNA policy documents and/or application process:

- 48 • **Continuous Dimming:** The capability of a control system to provide control with sufficient
 49 resolution in output (100+ steps) to support light level changes perceived as smooth (as
 50 opposed to step dimming with a small number of discrete light levels).

- 51 • **Light pollution**¹: Light pollution is the combination of all the adverse or obtrusive effects of
52 electric light that produces artificial sky glow:
- 53 ○ Unnecessary, unwanted, or wasted light
 - 54 ○ Light that damages or degrades the nighttime environment
 - 55 ○ Light that negatively impacts humans and other species
- 56 • **Light trespass**²: The encroachment of light, typically across property boundaries, causing
57 annoyance, loss of privacy, or other nuisance. Also called spill light or obtrusive light.
- 58 • **Rayleigh scatter**²: The dispersion of electromagnetic radiation by particles much smaller than
59 the wavelength of the radiation. The amount of scatter varies inversely as the fourth power of
60 the wavelength, resulting in short wavelengths being scattered far more than longer
61 wavelengths.
- 62 • **Receptacle: ANSI C136.41-2013**: This standard defines the mechanical and electrical interface
63 between an outdoor LED luminaire and a photocell, typically mounted on top of the luminaire.
64 The dimensions of the receptacle are roughly 1.5" high x 2.5" diameter.
- 65 ○ **NEMA 5-pin**: The 5-position receptacle has three line-voltage power contacts plus two
66 dimming/signal contacts.
 - 67 ○ **NEMA 7-pin**: The 7-position receptacle has three line-voltage power contacts plus four
68 dimming/signal contacts. The 7-pin configuration supports field upgrades of the control
69 capabilities of LED luminaires by adding or changing wirelessly networked controllers
70 with sensing and communication abilities.
- 71 • **Receptacle: ANSI C136.58-2019 (Zhaga Book 18)**: This standard defines the mechanical and
72 electrical interface between an outdoor LED luminaire and modules for sensing and
73 communication. The data interface is defined by the digital D4i/ANSI C137.4 standard. The
74 specification supports field upgrades of the control capabilities of LED fixtures, by adding or
75 changing 24V modules that provide sensing and communication abilities. The dimensions are
76 roughly 1.1" high x 1.5" diameter.
- 77 • **Receptacle: Z10**: This interface design adds low-voltage controls to analog 0-10V dimmable
78 outdoor luminaires. It is in consideration by ANSI C136 as a future standard. The mechanical
79 format is similar, but not identical, to Zhaga Book 18.
- 80 • **Sky glow**²: The brightening of the night sky that results from the scattering and reflection of light
81 from the constituents of the atmosphere (gaseous molecules and aerosols), in the direction of
82 the observer. It has two components: natural sky glow and artificial sky glow.
- 83 • **Subgroups**
- 84 ○ **Mounting subgroup**: V5.1 outdoor lighting PUDs may include a variety of mounting
85 options, some of which are eligible for LUNA qualification and some of which are not.
86 The mounting subgroup is the grouping of products within a V5.1 family that conform

¹ ANSI/IES LP-11-20: <https://store.ies.org/product/lp-11-20-lighting-practice-environmental-considerations-for-outdoor-lighting/>

² ANSI/IES LS-1-20: <https://www.ies.org/definitions/>

87 with the fixed mounting or minimal tilt requirements in the LUNA distribution Technical
88 Requirements.

- 89 ○ **Shield type subgroup:** V5.1 outdoor lighting PUDs may include a variety of shield types,
90 such as house-side shields (HSS), cul-de-sac shields (CSS), or front-side shields (FSS) as
91 long as the minimum LUNA efficacy requirements are met. Shield types typically reduce
92 luminaire efficacy, some of which are eligible for LUNA qualification and some of which
93 are not. The shield type subgroup is the grouping of products within a V5.1 family that
94 conform with the shielding requirements in the LUNA distribution Technical
95 Requirements. Shield type subgroups cannot be combined. A HSS subgroup, for
96 example, can only contain products with house-side shields, not cul-de-sac shields or
97 front-side shields.
- 98 ○ **Spectral subgroup:** V5.1 outdoor lighting PUDs may include a variety of spectral options,
99 some of which are eligible for LUNA qualification and some of which are not. The
100 spectral subgroup is the grouping of products within a V5.1 family that conform with the
101 chromaticity requirements in the LUNA spectral Technical Requirements.

102 Two Sets of Requirements: DLC SSL V5.1 and LUNA

103 To attain DLC LUNA qualification, products must meet the [SSL V5.1 Technical Requirements](#) as a
104 baseline, in addition to the LUNA Technical Requirements outlined in this document. For eligible
105 products utilizing optical shielding to meet the LUNA Technical Requirements, the LUNA requirements
106 provide efficacy allowances to the baseline SSL V5.1 efficacy threshold. In other words, a shielded
107 product with relatively low efficacy might qualify for LUNA because of the efficacy allowance.

108 The complete SSL V5.1 Technical Requirements [can be viewed on the DLC's website](#). They apply to
109 indoor and outdoor luminaires, lamps, and retrofit kits. The requirements for outdoor luminaires are
110 summarized for the reader's convenience in the following section "Overview of SSL Baseline
111 Requirements". Please note that these requirements have already been adopted and *are not* subject to
112 modification at this time.

113 After the "Overview of SSL Baseline Requirements", the following section "LUNA Version 1 Technical
114 Requirements" describes the additional requirements that a product must meet to attain LUNA
115 qualification. The LUNA requirements have not yet been adopted and *are* subject to review and
116 comment.

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Overview of SSL Baseline Requirements

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Table 2 summarizes the existing [SSL V5.1 Technical Requirements](#) for outdoor Primary Use Designations. *For products seeking LUNA qualification, the highlighted V5.1 requirements are superseded by the LUNA requirements as described in subsequent sections of this policy.*

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Table 2: Overview of where LUNA requirements supersede existing DLC SSL V5.1 Technical Requirements for Outdoor Luminaires

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Topic	Overview of SSL V5.1 Requirements for Outdoor Luminaires
Light Output and Efficacy	<ul style="list-style-type: none"> • Minimum light output by General Application and PUD • Minimum efficacy: <ul style="list-style-type: none"> ○ Standard: 105 lm/W ○ Premium: 120 lm/W • Efficacy allowances are available for luminaires with low CCT ($\leq 2700\text{K}$) and/or high color rendition
Light Distribution	<ul style="list-style-type: none"> • Zonal Lumen distribution requirements by PUD • BUG Ratings reported
Spectral Quality	<ul style="list-style-type: none"> • Color Rendition: <ul style="list-style-type: none"> ○ Option 1 - ANSI/IES TM-30-18: <ul style="list-style-type: none"> ▪ IES $R_f \geq 70$ ▪ IES $R_g \geq 89$ ▪ $-18\% \leq \text{IES } R_{cs,h1} \leq +23\%$ ○ Option 2 - CIE 13.3-1995: <ul style="list-style-type: none"> ▪ $R_a \geq 70$ ▪ Report R_9 • Correlated Color Temperature (CCT): 2200K – 6500K • Color maintenance: maximum chromaticity shift ($\Delta u'v' \leq 0.007$)
Controllability	<ul style="list-style-type: none"> • Continuous or stepped -dimming required <ul style="list-style-type: none"> ○ Standard: Stepped dimming to $\leq 70\%$ of full light output ○ Premium: Continuous dimming to $\leq 20\%$ of full light output • Integral control sensors and capabilities reported • Communication protocols reported
Lumen Maintenance	<ul style="list-style-type: none"> • Standard: $L_{70} \geq 50,000$ hours • Premium: $L_{90} \geq 36,000$ hours
Electrical Performance	<ul style="list-style-type: none"> • Minimum Power Factor (PF): ≥ 0.90 • Maximum Total Harmonic Distortion (THD): $\leq 20\%$
Warranty	<ul style="list-style-type: none"> • Minimum Warranty: 5 years

LUNA Version 1 Technical Requirements

These Technical Requirements have not yet been adopted and are subject to review and modification.

Scope of Technical Requirements

Version 1 of the LUNA Technical Requirements establishes pathways for DLC LUNA qualification for luminaires that minimize light pollution, minimize lighting energy use, and provide appropriate visibility for people. Version 1 addresses metrics for light distribution by establishing requirements and reporting standards for distribution; spectral quality by limiting eligible CCTs; and controllability by setting required dimming thresholds using common industry standards - all of which are intended to mitigate light trespass and sky glow.

Some aspects of outdoor lighting are beyond the scope of Version 1. Research and standards for outdoor lighting continue to evolve. While various effects of outdoor lighting on humans and on other species are the topics of ongoing research, metrics are still under development. As more predictive metrics become standardized to address issues such as discomfort glare, sky glow, and the interactions of spectral components with various species at various times of the night and year, these metrics will be incorporated into future revisions of the LUNA policy.

LUNA Light Distribution Requirements

Rationale

Uplight emitted directly from luminaires is unused light, wasting energy and increasing sky glow³. In some applications, environmental features like buildings, trees, canopies, and other surfaces prevent uplight from luminaires and other reflective surfaces from reaching the atmosphere and causing sky glow. However, these features are not present in all applications and no consensus performance model exists that takes surface reflection and obstruction into account. As a result, the LUNA Technical Requirements use prescriptive Uplight Rating thresholds from BUG Ratings (as defined by Annex A in the [ANSI/IES TM-15-20 Luminaire Classification System for Outdoor Luminaires](#)) to set maximum limits on uplight emitted directly (light ≥ 90 degrees) from listed luminaires. PUDs that are typically installed under overhead surfaces, such as fuel pump canopy lighting, are allowed a higher threshold U Rating value, under the assumption that the overhead surface will stop much of the uplight from reaching the sky dome.

BUG ratings have been adopted and are referenced by many national, state and/or local ordinances, regulations, and policies. They are also required by both primary and secondary reference such as LEED

³ https://www.energy.gov/sites/prod/files/2017/05/f34/2017_led-impact-sky-glow.pdf

153 v4.1, LEED for Cities and Communities, and the WELL Community Standard. BUG rating data in the
154 Distribution and Glare tab of the DLC SSL QPL will support compliance with these regulations.

155 Luminaires with auxiliary shielding may improve the quality of the light distribution, as light is only
156 delivered where it is intended, rather than potentially causing light trespass on neighboring locations.
157 Shields may also be used to address glare complaints proactively or retroactively. Manufacturers may
158 offer a variety of shielding options such as house-side shields, cul-de-sac shields, front-side shields, and
159 glare shields. The DLC acknowledges that luminaire efficacy will be reduced with a shield mounted in the
160 field and is introducing a LUNA efficacy allowance to encourage well-shielded products to be listed on
161 the QPL.

162 **Draft LUNA Testing and Reporting Requirements for Light Distribution**

163 The following section outlines the proposed LUNA requirements for light distribution. **Table 3** includes
164 columns for the metric or application and its associated requirements. The “QPL Listing” column
165 describes the information that appears as publicly available on the Qualified Products List, if applicable.
166 The “Method of Evaluation” column describes how the products will be evaluated for qualification,
167 whether by compliance with industry standards, manufacturer claims, or other DLC verification
168 methodology.

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170 **Table 3: Draft LUNA Distribution Testing and Reporting Requirements**

Metric and/or Application	LUNA V1 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
<p>Uplight Rating (from the IES BUG system)⁴</p>	<p>Products shall have a U-Rating of 1 or 2, depending on Primary Use Designation indicated in Table 4.</p> <p>Parent products or single products shall submit an ANSI/IES TM-33-18 .xml document containing luminous intensity distribution data along with an accompanying image of this distribution (a polar plot image showing the horizontal cone and vertical slice through maximum candela) submitted as a .jpg file, at a minimum size of 1000x1000 pixels or larger.</p>	<p>BUG ratings for parent products will be generated by the DLC using tested photometric data and listed under the Tested Data section. BUG ratings for child products are reported by the applicants and listed under the Reported Data section.</p> <p>The .jpg image submitted with the parent TM-33-18 .xml document will be shown on the QPL.</p>	<p>ANSI/IES LM-79-19 per the <i>Additional Reporting Guidelines</i></p> <p>BUG ratings generated per ANSI/IES TM-15-20 Annex A using luminaire photometric data</p>
<p>Aiming</p>	<p>Products shall only include mounting options that will not allow tilt angles beyond +/- 5 degrees (see Figure 1)</p>	<p>Model number will include allowed mounting options.</p>	<p>Specification sheet or installation instructions shall include images of mounting options with allowable tilt angles or fixed mounting options clearly documented.</p>
<p>Shielding</p>	<p>Shielding options shall be included on specification sheet (e.g. house side shields (HSS), cul-de-sac shields (CSS), front-side shields (FSS), or glare shields) for pole/arm-mounted area/roadway/decorative PUDs (Primary Use Letters A and B), and specialty hazardous area lighting and specialty hazardous pole/arm-mounted area and roadway PUDs</p>	<p>Within each given shielding subgroup, shielded products with the lowest efficacy products will be listed as worst-case-efficacy parent products on the QPL. Other eligible members of the given shielded subgroup will be listed as child products.</p>	<p>Specification sheet review to determine that at least one shielding option is available and graphically shown.</p> <p>For worst-case-efficacy parents, shielded product performance relative to the same unshielded product performance will be assessed using .ies (.xml) files.</p>

⁴ Performance affecting mounting structures (e.g. post-top yokes or brackets) must be included in photometric testing for Outdoor Pole/Arm-Mounted Area and Roadway Luminaires (Primary Use Letter A) and Outdoor Pole/Arm-Mounted Decorative Luminaires (Primary Use Letter B).

171 **Table 4:** PUDs eligible for LUNA qualification and respective U Rating thresholds

Primary Use Letter	Primary Use Designations Eligible for LUNA Qualification	U Rating Threshold
A	Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
B	Outdoor Pole/Arm-Mounted Decorative Luminaires	2
C	Outdoor Full-Cutoff Wall-Mounted Area Luminaires	1
D	Outdoor Non-Cutoff and Semi-Cutoff Wall-Mounted Area Luminaires	2
E	Bollards	1
F	Parking Garage Luminaires	2
G	Fuel Pump Canopy Luminaires	2
	Specialty: Hazardous Area Lighting	1
	Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires	1
	Specialty: Hazardous Wall Mounted Luminaire	2
	Specialty: Canopy Lighting	2
	Specialty: Directional Fuel Pump Canopy Luminaires	2
	Specialty: Transportation	2

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 173 The lighting distribution test reports required to qualify parent products or single product applications
 174 under the LUNA qualification are described as follows:
- 175 • A full LM-79-19 distribution report in PDF format per the *Additional Reporting Guidelines* for the
 176 products that have the highest total lumen output for each optical variation within the family at
 177 the highest qualifying CCT (e.g. 3000K), tested at the maximum (non-dimmed) light output.
 - 178 • A TM-33-18 .xml document based on the LM-79-19 test data must be submitted along with the
 179 PDF distribution report.
 - 180 • A product image including performance affecting mounting structures or shielding must be
 181 included in the PDF distribution report.
 - 182 • For a single product application or the parent products in a family grouping application,
 183 threshold U Ratings from the BUG ratings will be verified using the .xml documents associated
 184 with the full LM-79-19 distribution test report.
 - 185 • For all child products in a family grouping application where LM-79-19 distribution reports are
 186 not required, reported data, including BUG ratings, shall be reported in the reported values on
 187 the application form.
 - 188 • DLC reviewers will use Photometric Toolbox (Lighting Analysts, Inc., version 2.7 or newer) to
 189 verify BUG Ratings and house-side or street-side lumens (for products pursuing efficacy
 190 allowances) using the submitted tested photometric files.

191 All products in the applicable outdoor luminaire categories shall input their BUG ratings on the Reported
192 Performance Table tab of the application form. BUG values for rated data are listed as Reported Data in
193 the Distribution and Glare tab in the SSL QPL. The BUG ratings entered on the Reported Performance
194 Table tab of the application form may be generated either from the photometric data in the ANSI/IES
195 LM-79 test report or by manufacturer's own calculation method based on the tested or scaled data,
196 provided that the procedures in ANSI/IES TM-15-20 Annex A are followed. In addition, for a single
197 product application and for the parent products in a family grouping application, tested BUG ratings will
198 be generated by the DLC reviewer using the photometric data from the submitted LM-79/distribution
199 report (.ies file) and listed under Tested Data in the Distribution and Glare tab of the SSL QPL.

200 DLC reviewers will evaluate drawings and text information on the submitted specification sheets and
201 installation instructions to verify that the qualified mounting bracket does not allow a tilt angle greater
202 than 5 degrees. The mounting bracket and related maximum tilt angle must be graphically shown on
203 either the specification sheet or installation instructions (see **Figure 1**).

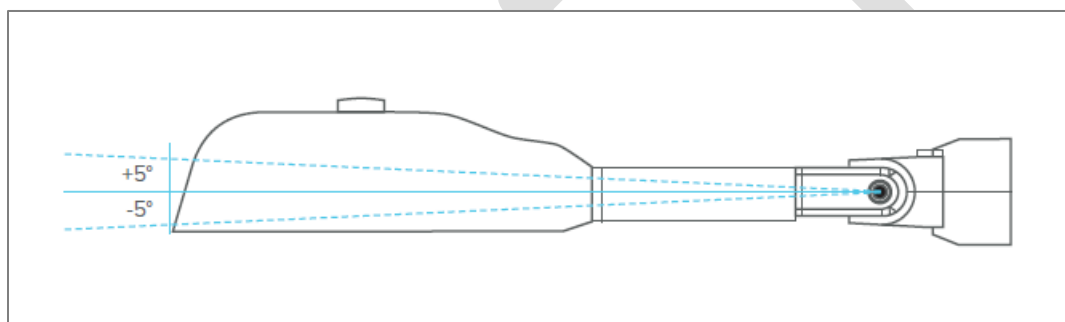


Figure 1: Acceptable mounting bracket tilt angle for LUNA qualification.

206 To attain LUNA Qualification, listed pole/arm-mounted area/roadway/decorative PUD products shall
207 offer at least one specifiable shielding option, to be installed on the luminaire in the field, on the
208 product specification sheet. The shields may be external to the luminaire, or internal to the glass or
209 optic, but must be graphically shown on the specification sheet. DLC reviewers will evaluate
210 specification sheets to ensure that shields are available as part of the catalog number specification.

211 In all cases, products with multiple mounting options must meet all other SSL V5.1 and LUNA Technical
212 Requirements. For example, in a family that includes multiple mounting options, some of which are
213 eligible for LUNA, and some which are not, only the subgroup of mounting options which does not allow
214 a tilt angle greater than 5 degrees would be eligible for LUNA, and the remaining family members would
215 be listed under SSL V5.1 only.

216 QPL Listing: Shielded Products

217 As demonstrated in **Table 5** below, if a manufacturer offers more than one configuration of a specific
218 shield type (HSS, CSS, and FSS), the variety of configurations under each shield type is treated as a shield
219 type subgroup within the product family (e.g. An HSS subgroup could include internal vs. external HSS,
220 or an HSS subgroup could include a Type II HSS with a 30-degree cutoff and a Type II HSS shield with a
221 45-degree cutoff). For each shield type subgroup (e.g. HSS), each shield configuration and its effect on a

222 specific distribution and light output is listed as a separate reported family member. Shield color must
 223 be specified in the model number and cannot be listed as a wildcard option in the listing, because lighter
 224 color shields will potentially reflect more light to the sky dome.

225 In all cases, shielded products must meet all other V5.1 and LUNA Technical Requirements, besides
 226 efficacy and reduction in house side lumens. For example, if a family includes shielding options, some of
 227 which are eligible for an allowance, and some of which are not, testing would be required at the worst-
 228 case-*efficacy* shielded option that meets the allowance requirement, for the specific subgroup of
 229 products for a given shield (e.g. HSS or CSS) which want to be granted the allowance, and the remaining
 230 subgroup members must also meet the minimum reduction in house side lumens.

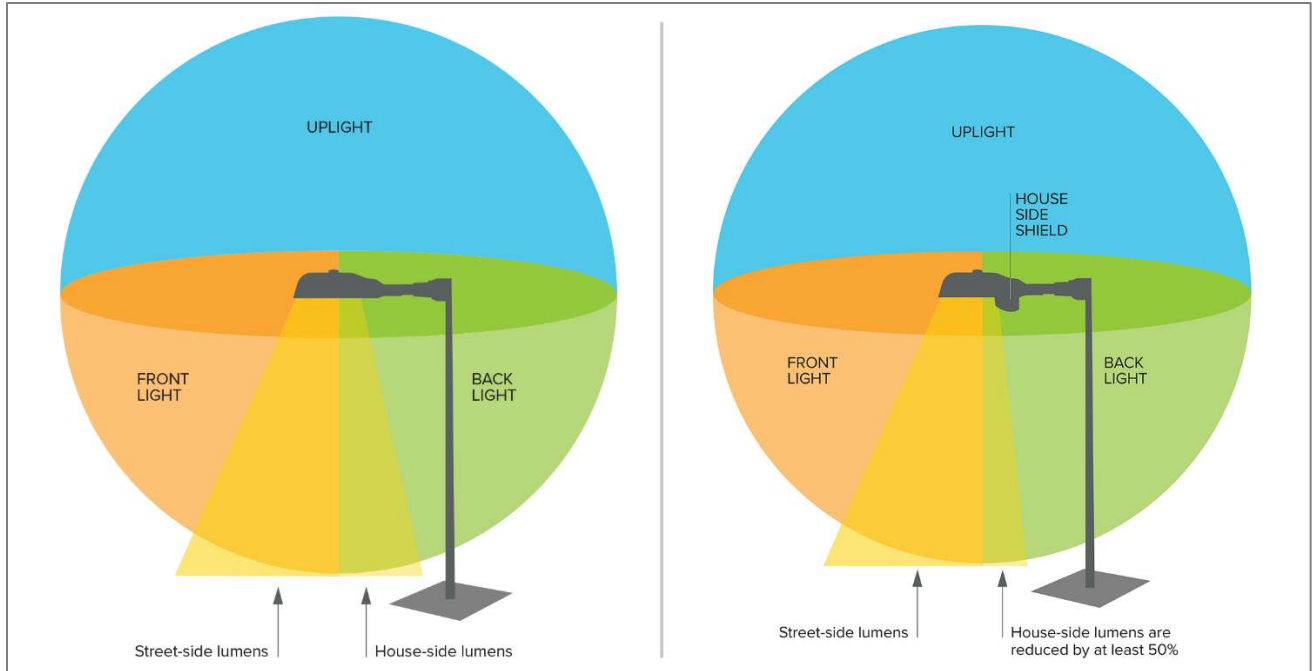
231 The worst-case-*efficacy* parent product in the given shielding subgroup must be tested with the shield
 232 attached and is defined as the product with the lowest efficacy with a specific shield attached, for any
 233 associated luminaire with a relevant distribution and light output. Child products in the given shielded
 234 subgroup are shielded products with the same shield type but with higher luminaire efficacies and
 235 different light outputs and distributions. The DLC does not consider distributions changed by a given
 236 shield type as requiring additional testing beyond that required to establish worst-case-*efficacy* parent
 237 data for the subgroup of products which want to be granted the allowance. Shield types cannot be
 238 combined to create a larger subgroup. In other words, cul-de-sac shields and house-side shields cannot
 239 be combined to create one subgroup.

240 **Table 5** provides an example of a luminaire family with various HSS and FSS options. The worst-case-
 241 *efficacy* parent is the product with the HSS and FSS that results in the lowest efficacy, assuming that all
 242 HSS products in the subgroup reduce the house-side lumens by at least 50% compared to an unshielded
 243 product with the same given optic and chromaticity, and all FSS products reduce the street-side lumens
 244 by at least 30% compared an unshielded product with the same given optic and chromaticity.

245 **Table 5:** Example of hypothetical shielded products and identified worst-case-*efficacy* parents
 246 for one luminaire family with two shield type subgroups (HSS and FSS).

Family Name	Optic	Luminaire Efficacy w/o shielding (LPW)	House-side (<i>or street-side</i>) lumens w/o shield	Shield Type	Shield Angle	Shield Type Sub-group	Luminaire Efficacy with shield (LPW)	House-side (<i>or street-side</i>) lumens with shield
AXBXC	Type II	125	3000	HSS	30	A	85	1400
AXBXC	Type II	125	3000	HSS	45	A	88	1400
AXBXC	Type III	125	3500	HSS	30	A	87	1500
AXBXC	Type III	125	3500	HSS	45	A	89	1500
AXBXC	Type II	125	10000	FSS	30	B	88	6500
AXBXC	Type II	125	10000	FSS	45	B	90	6500
AXBXC	Type III	125	9500	FSS	30	B	89	6000
AXBXC	Type III	125	9500	FSS	45	B	91	6000

247 *Worst-case-*efficacy* parent for each Shield Type Subgroup shown in yellow. LM-79 distribution testing is required for the least
 248 efficacious shielded luminaire in Shield Type Subgroup A (HSS), and the least efficacious shielded luminaire in Shield Type
 249 Subgroup B (FSS).



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Figure 2: Example of a hypothetical product with a house-side-shield (HSS) (right image) and without (left image). This hypothetical product with a HSS would be eligible for an efficacy allowance if the house-side lumens are reduced by at least 50% compared to the unshielded product with the same optical distribution and light output. Note that other efficacy allowances for other shield types will require different reduction in house side or street side lumens. See the [LUNA Allowances and Tolerances](#) section for more information.

257 **Interactions with Other DLC Policies**

258 Field-adjustable light distribution (FALD) products are not eligible for LUNA qualification, except for
259 brackets that only allow vertical tilt angles up to 5 degrees, and except for luminaires utilizing house-side
260 shielding (HSS) as [standard FALD components](#), as long as they meet the worst-case-efficacy
261 requirements to receive an allowance. Field-adjustable light output (FALO) products are eligible, as long
262 as the product is tested at the maximum light output setting.

263 **Key Questions**

- 264 1. Should the DLC consider specifying separate lumen thresholds for the Uplight Low (UL) secondary
265 solid angle and the Uplight High (UH) secondary solid angle rather than using a threshold U Rating?
266 If so, what thresholds are required for each secondary solid angle and why?
- 267 2. Are optional QPL reporting listings desirable for shielding options on other LUNA-eligible PUDs,
268 such as bollards, or canopy lighting?
- 269 3. The DLC is proposing to allow applicants to use scaled data for unshielded products as part of the
270 process for applicants pursuing efficacy allowances for shielded products. Should the comparative
271 unshielded product data used to determine the relative reduction in house-side or street-side
272 lumens be submitted as absolute test data instead?

- 273 4. The DLC is proposing showing an image of the luminous intensity distribution for parent products
274 on the QPL. Should the DLC consider sharing TM-33 xml data instead of images of the
275 distributions?
- 276 5. Are there any other Primary Use Designations (PUDs) that DLC should consider?
- 277 6. Is other terminology used to describe the listed shield types, such as house-side shields or cul-de-
278 sac shields, instead of the terminology given here?

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279 LUNA Spectral Quality Requirements

280 Rationale

281 The DLC is proposing spectral quality requirements to mitigate negative impacts of outdoor LED lighting
282 at night. The draft requirements align with industry standards recommended for mitigating sky glow
283 (e.g. [ANSI/IES LP-2-20 Lighting Practice: Designing Quality Lighting for People in Outdoor Environments](#)
284 and [ANSI/IES LP-11-20 Lighting Practice: Environmental Considerations for Outdoor Lighting](#)) while
285 facilitating visibility and energy efficiency for continued acceptance of and persistent energy savings
286 achieved through LED lighting at night.

287 Since sky glow (and more specifically the Rayleigh scatter² causing sky glow) is wavelength dependent,
288 DOE³ found CCT to be a poor predictor of sky glow. Research and solutions for considering spectral
289 impacts on sky glow are emerging, but there is no industry standard consensus-based metrics in place to
290 date. In the meantime, industry best practices limit the maximum CCTs in outdoor environments to
291 reduce short-wavelength emissions. [ANSI/IES LP-11-20](#) recommends maximum CCTs of 3000 Kelvin (i.e.
292 3000 K) for area lighting in commercial zones, and CCTs lower than 2200 K⁵ for area lighting in sensitive
293 environments.

294 Draft LUNA Testing and Reporting Requirements for Spectral Quality

295 The Spectral Quality draft Testing and Reporting Requirements for all LUNA products are shown in **Table**
296 **6**. The “QPL Listing” column describes the information that appears as publicly available on the Qualified
297 Products List, if applicable. The “Method of Evaluation” column describes how the products will be
298 evaluated for qualification, whether by compliance with industry standards, manufacturer
299 documentation, or other DLC verification methodology.

⁵ No ANSI (or other) standards define CCT ranges extending beyond what is considered ‘white’ lighting per ANSI C78.377-2017. As such, the DLC is proposing that non-standardized chromaticities are ineligible for listing under LUNA V1.

300 **Table 6: Draft LUNA Spectral Quality Testing and Reporting Requirements**

Metric and/or Application	LUNA V1 Draft Requirements	QPL Listing	Method of Measurement/Evaluation
Chromaticity (CCT & D_{uv})	<p>Products shall exhibit chromaticity consistent with at least one of the basic, flexible, or extended, nominal 7-step quadrangle CCTs from 2200 K – 3000 K.</p> <p>Products shall submit an ANSI/IES TM-33-18 .xml document containing spectral power distribution data along with an accompanying image of this distribution submitted as a .jpg file, at a size of 1000x1000 pixels or larger.</p>	<p>SPD image, CCT and D_{uv} for parent products listed as Tested Data</p> <p>Nominal CCT for child products listed as Reported Data</p>	<p>ANSI/IES LM-79-19 (per <i>Additional Reporting Guidelines</i>)</p> <p>ANSI C78.377-2017</p>

301 In addition to test report and implementation requirements applicable to DLC Standard and Premium
 302 classifications, this section describes the test reports required to meet LUNA spectral quality
 303 requirements.

- 304 • Product families seeking qualifications to the SSL QPL may include both products seeking, and
 305 products not seeking the LUNA qualification. Subsets of products seeking LUNA qualification
 306 within a larger family will be considered spectral subgroups.
- 307 • Complete LUNA product families and LUNA-specific spectral subgroups are required to test and
 308 report the following:
 - 309 ○ For product families or spectral subgroups that offer **one color rendition option and**
 310 **one or more CCT option(s)**:
 - 311 ■ A full LM-79/color report, per the *Additional Reporting Requirements*, shall be
 312 provided at the lowest and highest CCT options offered.
 - 313 ○ For product families or spectral subgroups that offer **one or more color rendition**
 314 **option(s) and one CCT option**:
 - 315 ■ A full LM-79/color report, per the *Additional Reporting Requirements*, shall be
 316 provided at the minimum color rendition option for the CCT option offered.
 - 317 ○ For product families or spectral subgroups that offer **one or more color rendition**
 318 **option(s) and one or more CCT option(s)**:
 - 319 ■ A full LM-79/color report, per the *Additional Reporting Requirements*, shall be
 320 provided for the lowest and highest CCT options offered, at the minimum color
 321 rendition option.
 - 322 ○ Optional testing beyond the testing described above is encouraged and reporting of
 323 data on the QPL is possible, if of interest to the applicant.
 - 324 ○ All LM-79/color tests of the highest CCT option offered shall be conducted at the highest
 325 total lumen output for at least one optical variation within the family when operating at

326 the maximum (non-dimmed) light output and the .xml document based on the LM-79-
327 19 test data shall include both spectral and spatial distribution data per the *Additional*
328 *Reporting Requirements*.

329 ▪ For the spectral parent with the highest CCT (at highest lumen output), the TM-
330 33 .xml document shall include both the emitter spectral data and the emitter
331 luminous intensity data for a single tested product.

332 ▪ For the spectral parent with the lowest CCT (at highest lumen output), the TM-
333 33 .xml document may include only the emitter spectral data without the
334 emitter luminous data for a single tested product.

335 **Interactions with Other DLC Policies**

336 For color-tunable (white-tunable and warm-dimming) products, additional clarifications to meeting the
337 proposed LUNA spectral quality requirements are provided below.

- 338 • White-tunable and warm-dimming products are eligible for LUNA but shall not be tunable to
339 chromaticities outside the proposed LUNA chromaticity requirements (i.e., color-tunable
340 products are eligible for LUNA, so long as the product(s) tune between 2200 – 3000 K).

341 **Key Questions**

342 1. The DLC has proposed that color-tunable products that can tune to non-white and/or ineligible
343 CCTs (per LUNA requirements) are not eligible for LUNA qualification. Should the DLC consider
344 LUNA Qqualification eligibility for color-tunable products that can deliver spectra beyond currently
345 eligible chromaticities? If so, what additional information or functionality should be required to
346 mitigate misuse?

347 2. The DLC has proposed that the maximum and minimum CCT options undergo LM-79 testing and
348 are required to provide SPD images as accompanying elements to the TM-33-18 document, which
349 will be listed on the QPL for download. What, if any, formatting considerations should be taken
350 into account to ensure the QPL provides useful information to users of the QPL?

351 3. While the limitations of CCT being used as a metric for accurately and consistently predicting the
352 impact of spectra on sky glow (or Rayleigh scatter) are well known, the DLC seeks your input. Are
353 consensus-based standards or alternative metrics available for quantifying the impact of spectra
354 on Rayleigh scatter and/or sky glow?

355 4. The DLC has proposed industry standardized CCTs (per [ANSI C78.377-2017](#)) between 2200 and
356 3000 K as eligible for LUNA listing. Recognizing that some non-white chromaticities spectra (e.g.
357 narrowband amber) and CCTs below 2200 K are desirable for area lighting in sensitive outdoor
358 environments, the DLC seeks your input. Are standards that extend the ANSI C78.377 CCT range to
359 below 2200 K under development? Is there an applicable standard that the DLC could reference
360 that could enable eligibility of non-white spectra and/or lower CCTs not included in ANSI C78.377?

361 **LUNA Controllability Requirements**

362 **Rationale**

363 Sky glow and light trespass can be reduced flexibly throughout the night by dimming down as far as
364 appropriate, as frequently as appropriate. Solutions include luminaires with stand-alone motion sensors
365 and photocells; smart photocells with part-night-dimming and field adjustable high end trim; and
366 networked lighting controls (NLC) with remote diagnostics, scheduling, dashboards, etc. In many
367 applications, reducing light output can reduce light pollution while saving energy by delivering precisely
368 the illumination that is needed, only when it is needed. For instance, when a limited selection of driver
369 power options is available to a specifier, and the only drivers available are either undersized or
370 oversized, then the driver selected is typically oversized for the application. In that case, continuous
371 dimming combined with high end trim can reduce light pollution and energy use substantially.
372 Continuous dimming also facilitates compliance with energy code requirements for light level reduction,
373 including recent versions of ASHRAE 90.1, IECC, and California’s Title 24.

374 **Draft LUNA Testing and Reporting Requirements for Controllability**

375 The following section outlines the proposed LUNA requirements for controllability. The “QPL Listing”
376 column describes the information that appears as publicly available on the Qualified Products List. The
377 “Method of Evaluation” column describes how the products will be evaluated for qualification, whether
378 by compliance with industry standards, manufacturer claims, or other DLC verification methodology.

379 Note that every LUNA product must identify its dimming standard protocol between driver and sensor/
380 controller. For instance, if a product family of luminaires is available with optional dimming, where some
381 members of the family can dim and some cannot, only those members of the family that support
382 dimming controls are eligible for LUNA qualification.

383 **Table 7:** Draft LUNA controllability testing and reporting requirements (*not required for*
 384 *Specialty Primary Use Designations intended for hazardous locations*)

Metric	LUNA V1 Draft Requirements	QPL Listing	Method of Evaluation
Dimming Capability	Continuous dimming capability to $\leq 20\%$ of maximum output power is required.	Minimum dimming level (integer %)	Product specification sheet shall clearly identify continuous dimming capability, to a percentage of maximum output current or power, less than or equal to 20%.
Dimming standard protocol between driver and sensor/controller	The dimming standard protocol is required	Dimming standard protocol	<p>Product specification sheet and SKU shall clearly identify one standard selected from the list below. If a single driver can accept both analog and digital input, then the analog and digital standards are both identified.</p> <ul style="list-style-type: none"> • Wired, Analog <ul style="list-style-type: none"> ○ 0-10V IEC 60929 Annex E ○ 0-10V ANSI C137.1-2019 (8-Volt) ○ 0-10V ANSI C137.1-2019 (9-Volt) • Wired, Digital <ul style="list-style-type: none"> ○ DALI ○ DALI 2 ○ D4i
Integral Controls	Capability for integral controls is reported.	Integral control capabilities and receptacle(s)*	Product specification sheet shall clearly identify available integral control capabilities and receptacles, if any, with the ordering code option for each.*
Communication standard protocol between luminaires and other devices	Communication standard protocol is reported.	Communication standard protocol(s)	Product specification sheet shall clearly identify available standards selected from Table 9 below, with the ordering code option for each.

385 * Table 8 below shows integral control capabilities beyond those listed in Table 8 of [SSL Technical Requirements V5.1](#), and also
 386 a list of integral control receptacles.
 387

388 **Dimming Capability**

389 Dimming is required in many energy codes, and the capability to dim down to 20% of maximum output
390 power addresses multiple dark sky challenges. High end trim and part night dimming are broadly
391 applicable; and occupancy-based dimming is applicable in some situations depending on sensor
392 performance related to coverage area, sensitivity, and mounting height.

393 **Dimming standard protocol between driver and sensor/ controller**

394 In order for a luminaire to dim, a sensor or control module communicates the desired dimming level to
395 the driver, using a dimming protocol. This protocol is typically either an analog 0-10V signal, or a digital
396 signal such as DALI, DALI2 or D4i.

397 **Integral Controls**

398 Several types of integral control sensors and capabilities are described in Table 8 of the [SSL V5.1](#)
399 [Technical Requirements section on Controllability](#)⁶. In addition, the following types of control
400 capabilities and receptacles are accepted by the LUNA program, as types of “Integral Controls”.

401 **Table 8:** Integral Control capabilities and receptacles recognized by LUNA, in addition to those
402 in SSL Technical Requirements V5.1

Topic	Additional types of integral controls	Method of evaluation
Integral control capabilities beyond those listed in V5.1	<ol style="list-style-type: none">1. Field adjustable high-end trim2. Part night dim3. Photocontrol with self-calibrating astronomic time clock4. Field adjustable low-end trim for vacancy mode	List of acceptable terms to be determined
Integral control receptacles for outdoor luminaires	<ol style="list-style-type: none">1. ANSI C136.41-2013 (NEMA 5-pin)2. ANSI C136.41-2013 (NEMA 7-pin)3. ANSI C136.58-2019 (Zhaga Book 18)4. Z10 (ANSI C136.xx possible)5. Other	List of acceptable terms to be determined

403

404 **Communication standard protocol between luminaires and other devices**

405 In order to support the selection of luminaires and control systems that are likely to work well together,
406 the information in **Table 9** below is reported for LUNA SSL products, in addition to the information about
407 control communication that is described in Table 9 of [SSL Technical Requirements V5.1](#). When a
408 luminaire and a control system share a common control protocol, they are more likely to work well
409 together—but that is not guaranteed, especially for analog control protocols.

⁶ <https://www.designlights.org/solid-state-lighting/qualification-requirements/technical-requirements-v5-1/?scrollTo=Controllability>

410 **Table 9:** Communication standard protocol between luminaires and other devices (reported
 411 capability)

Physical Medium	Standard Protocol	Method of Evaluation
Wireless	<ul style="list-style-type: none"> • Bluetooth Mesh <ul style="list-style-type: none"> ○ BLE MDP v2 ○ BLE SIG Mesh v1.x ○ BLE Proprietary • Cellular <ul style="list-style-type: none"> ○ 4G ○ 5G • EnOcean • WiFi • Zigbee <ul style="list-style-type: none"> ○ Zigbee 3.0 ○ Zigbee Proprietary • Other (describe) 	List of acceptable terms to be determined
Wired	<ul style="list-style-type: none"> • DALI • DALI2 • DMX • Other (describe) 	List of acceptable terms to be determined

412

413 **Key Questions**

- 414 1. Is the threshold of 20% for continuous dimming appropriate? If not, should it be higher or lower,
 415 and why?
- 416 2. For the Method of Evaluation column in Tables 8 and 9, what specific terms and phrases should be
 417 accepted on the product specification sheet?
- 418 3. On the QPL, how useful will the reported data about the communication standard protocols
 419 between luminaires and other devices be? This is shown in Table 7 bottom row, and Table 9.
 420 Should this be included as useful, or omitted as an unnecessary complication?
- 421 4. Should any standards be added to or omitted from Table 9?

422 **LUNA Allowances and Tolerances**

423 Luminaires with auxiliary shielding may increase the quality of the lighting distribution, as light is only
 424 delivered where it is intended and does not cause light trespass on neighboring locations. However, the
 425 application of shields often results in lower luminaire efficacies, and in many cases, shielded products
 426 cannot meet DLC’s minimum efficacy requirements.

427 To encourage the listing of shielded products, the DLC is providing efficacy allowances for shielded area
 428 lighting, roadway lighting and pole- or arm-mounted decorative lighting with house-side shields or cul-
 429 de-sac shields, if the related house-side lumens are reduced by the specified percentage compared to an
 430 unshielded product. A similar efficacy allowance is also provided for shielded area lighting, roadway
 431 lighting and pole- or arm-mounted decorative lighting with front-side shields, if the related street-side
 432 lumens are reduced by the specified percentage compared to an unshielded product.

433 **Table 9** shows the efficacy allowances for LUNA products with shielding. These allowances are
 434 cumulative to other cumulative spectral quality allowances provided in SSL V5.1. The maximum
 435 allowance for a shielded LUNA-designated product is not limited by the maximum allowance of 15% as
 436 stated in the SSL V5.1 requirements. Instead, for LUNA, it may be up to 50%, depending on the shield
 437 type.

438 There are no allowances for light output. All shielded and unshielded products seeking LUNA
 439 qualification must have a light output above 250 lumens.

440 **Table 10:** Efficacy allowances specific to LUNA products with shielding

Feature	Primary Use Designations	Performance Metric	Efficacy Allowance
Shielding	<ul style="list-style-type: none"> Outdoor Pole/Arm-Mounted Area and Roadway Luminaires Outdoor Pole/Arm-Mounted Decorative Luminaires Specialty: Hazardous Area Lighting Specialty: Hazardous Outdoor Pole/Arm-Mounted Area and Roadway Luminaires 	Luminaires with internal or external house-side shields (HSS) are offered an efficacy allowance of 20% if they reduce the house-side lumens by at least 50% compared to an unshielded product with the same distribution.	-20%
		Luminaires with internal or external cul-de-sac shields (CSS) are offered an efficacy allowance of 35% if they reduce the house-side lumens by at least 70% compared to an unshielded product with same distribution.	-35%
		Luminaires with internal or external front-side shields (FSS) are offered an efficacy allowance of 20% if they reduce the street-side lumens by at least 30% compared to an unshielded product with same distribution.	-20%

441

442 **Testing Notes**

443 To determine if the efficacy allowance may be granted for a single product application or a worst-case-
444 efficacy parent product, applicants must submit a TM-33 .xml document of the unshielded product, with
445 the same optical distribution and nominal light output as the submitted shielded worst-case-efficacy
446 parent. The TM-33 .xml document associated with the unshielded product does not need to use
447 absolute photometry if the product is not already a parent; scaled photometry is acceptable. The
448 submitted specification sheet should clearly show the relationship between the unshielded product and
449 shielded product for reviewer’s analysis.

450 **Tolerances**

451 The DLC accepts measurement tolerances to certain metrics listed in the SSL V5.1 Technical
452 Requirements. Please refer to the SSL V5.1 Technical Requirements for acceptable tolerances. There are
453 no higher upper tolerances to the threshold Uplight Ratings given in **Table 4** of this document.

454 **Additional Reporting Guidelines: ANSI/IES LM-79-19 Reports**

455 SSL products or family groupings shall be tested according to the guidelines in specified ANSI/IES
456 Lighting Measurement (LM) documents. Test reports generated by a test lab that complies with the DLC
457 LM-79 Testing Requirements will be accepted only if all optical and electrical performance are tested
458 and documented as described below. LM-79-19 reports are required; however, the DLC will grant a
459 grace period for LM-79-08 reports⁷, at which point LM-79-19 reports must be submitted to maintain
460 listing. All tests shall be conducted at the full output or non-dimmed state.

461 All submitted photometric test reports must comply with the full LM-79/color report or full LM-
462 79/distribution report definitions below. Configurations tested to produce full LM-79/color reports and
463 full LM-79/distribution reports will be listed as parent products on the QPL with the tested performance
464 data based on the QPL listing information in each applicable section. If a full LM-79/color report and full
465 LM-79/distribution report are provided on the same configuration, the tested performance listed on the
466 QPL will be the worst performing data set.

467 Test reports that require color performance information (generally expected to be from testing in an
468 integrating sphere, though gonio-spectroradiometer testing is also acceptable) do not require
469 distribution performance information, unless specified. These color-specific test reports are generally
470 referred to within this LUNA policy as “full LM-79/color reports” and shall include, but are not limited to,
471 the following:

- 472 • Electrical characteristics (wattage, input voltage, THD and PF)
- 473 • Total luminous flux
- 474 • Efficacy
- 475 • Chromaticity ((x,y) and (u',v'))
- 476 • CCT and D_{uv}
- 477 • ANSI/IES TM-30-18 Full Report (per Annex D, Figure D-3)
- 478 • CIE 13.3-1995 complete Color Rendering Index Detail
- 479 • A TM-33 (ANSI/IES TM-33-18) .xml document meeting the following requirements:
 - 480 ○ Test report number, test lab, issue date, manufacturer, and luminaire catalog number
 - 481 are correctly and pertinently indicated using the keywords [TEST], [TESTLAB],
 - 482 [ISSUEDATE], [MANUFAC], and [LUMCAT], respectively.
 - 483 ○ Emitter spectral data with absolute luminaire-level spectral power distribution data
 - 484 from 380-780 nm in ≤5 nm increments.
 - 485 ○ Provisionally, .spdx files (ANSI/IES TM-27) are accepted until the end of the grace period.

⁷ The end of the grace period will be determined and published later in the LUNA V1 draft process. The grace period will be sufficiently long to ensure that the industry is ready to provide all required test and reporting data.

- 486 ○ For the spectral subgrouping parent with the highest CCT and highest lumen output, the
487 TM-33 .xml document shall include both the emitter spectral data and the emitter
488 luminous intensity data for a single tested product.
- 489 ○ For the spectral subgrouping parent with the lowest CCT and highest lumen output, the
490 TM-33 .xml document may include only the emitter spectral data without the emitter
491 luminous data for a single tested product.
- 492 ○ TM-33 .xml documents containing spatial and/or spectral data must also be submitted
493 by the end of the grace period (to be determined at a later date) if not submitted with
494 the original application.
- 495 ● The product model number shall be present and match in both the TM-27/TM-33/LM-63 and
496 LM-79 documents
- 497 ● All information listed above, except the accompanying TM-33 and/or .SPDX document, shall be
498 included in a single LM-79 test report. Separate ANSI/IES TM-30-18 reports will not be accepted.

499 Test reports that require distribution performance information (generally expected to be from testing
500 with a goniophotometer) do not require color performance information, unless specified. These
501 distribution-specific test reports are generally referred to within this LUNA policy as “full LM-79
502 distribution reports” and shall include, but are not limited to, the following:

- 503 ● Electrical characteristics (wattage and input voltage)
- 504 ● Luminous intensity distribution (Candela array)
- 505 ● A photo of the product in the goniophotometer as tested with performance affecting structures
506 must be included in the test PDF report.
- 507 ● A TM-33 (ANSI/IES TM-33-18) .xml document meeting the following minimum requirements:
- 508 ○ Test report number, test lab, issue date, manufacturer, and luminaire catalog number
509 are correctly and pertinently indicated using the keywords [TEST], [TESTLAB],
510 [ISSUEDATE], [MANUFAC], and [LUMCAT], respectively.
- 511 ○ In the TM-33 document, the Intensity Scaling Element (4.5.13.2.4.1) shall be 'false',
512 meaning that the reported intensity data has not been scaled uniformly with respect to
513 laboratory measurements.
- 514 ○ In the TM-33 .xml document, the spatial distribution shall be presented as emitter
515 luminous intensity data.
- 516 ○ If a given parent product or single product has a unique optic and the highest lumen
517 output has been tested to meet both the spectral and distribution requirements, a TM-
518 33 .xml document shall be submitted with both spectral and spatial data within, rather
519 than the submitter providing separate TM-33 .xml documents.
- 520 ○ TM-33 .xml documents containing spatial and/or spectral data must also be submitted
521 by the end of the grace period, if not submitted with the original application.
- 522 ○ The emission areas in the TM-33 .xml document file shall appropriately reflect the
523 luminous opening of the luminaire. In no circumstances shall the emission areas be zero

524 or exceed the luminaire’s physical dimensions, and DLC reviewers will verify the
525 emission areas in the TM-33 .xml document against the luminaire physical dimensions
526 that are provided either in the specification sheet, LM-79 test report, or as separate
527 application submission materials.

- 528 ○ The angular resolution for the emitter luminous intensity data in the TM-33 .xml
529 document shall comply with the scanning resolution specified in LM-79 (Section 9.3.3 in
530 LM-79-08 and Section 7.3.3 in LM-79-19) and be fine enough to accurately characterize
531 the product’s intensity distribution. For products with a wide-angle, smooth intensity
532 distribution, the luminous intensity distribution data shall be in a resolution of 5 degrees
533 or less in the vertical plane and 22.5 degrees or less in horizontal planes. A smaller
534 vertical angular increment must be used for products whose luminous intensity changes
535 rapidly as a function of angle.
- 536 ○ Provisionally, .ies files (ANSI/IES LM-63-19 or ANSI/IES LM-63-02) are accepted until the
537 end of the grace period. For manufacturers submitting a LM-63-19 file, products must
538 be tested and reported using absolute photometry methods per IES LM-63-19, not
539 scaled photometry, and must include the File Generation Type Value 1.10000 or
540 1.11000 per IES LM-63-19 Table 2.
 - 541 ■ TM-33 files containing luminous intensity data and spectral data must also be
542 submitted by the end of the grace period if not submitted with the original
543 application.
- 544 ● Stray light removal for the purposes of determining the threshold U Rating must be performed
545 and reported according to LM-75-19 (Section 9.0 including the reporting requirements in section
546 9.5)
 - 547 ○ If applicants are using the provisional pathway and submitting LM-79-08 data, LM-75-19
548 does not need to be followed during the grace period but will need to be followed and
549 reported when applicants submit LM-79-19 reports.
- 550 ● To determine if the efficacy allowance may be granted for a single product application or a
551 worst-case-efficacy parent product, applicants must submit a TM-33 .xml document of the
552 unshielded product, with the same optical distribution and nominal light output as the
553 submitted shielded worst-case-efficacy parent. The TM-33 .xml document associated with the
554 unshielded product does not need to use absolute photometry if the product is not already a
555 parent; scaled photometry is acceptable. The submitted specification sheet should clearly show
556 the relationship between the unshielded product and shielded product for reviewer’s analysis.

557 Test reports containing only a partial set of LM-79 metrics (for example, an integrating sphere test
558 report without luminous flux reported), will not be accepted for application review purposes. For clarity,
559 even if a test is needed for purposes of verifying chromaticity, it must be a full LM-79/color report as
560 described herein, with all required metrics reported.