



# Testing and Reporting Requirements for LED-based Horticultural Lighting

Version 2.1 – Draft 1

Proposed Effective Date: July 1, 2021

Horticultural lighting products using LEDs must comply with the provisions of this document to be eligible for listing on the DLC Solid-State Horticultural Lighting Qualified Products List (“Horticultural QPL”, “Hort QPL”). Products eligible for DLC qualification must be complete LED light fixtures. That is, they must be electromagnetic radiation-generating devices analogous to luminaires (or fixtures) as defined by ANSI/IES RP-16 sections 6.8.5 and 10.3.1.

## Definitions

Unless otherwise noted, DLC policy nomenclature directly references the definitions from the American Society of Agricultural and Biological Engineers (ASABE) *ANSI/ASABE S640: Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)*, and, where applicable, the Illuminating Engineering Society (IES) *ANSI/IES RP-16: Nomenclature and Definitions for Illuminating Engineering*, with key deviations or interpretations noted. Each mention of the term “LED device” in this document is meant to reference LED packages, modules, or arrays.

## Eligibility

Products designed and intended to operate with standard North American nominal AC line voltages (typically 120V – 480V) are eligible for DLC qualification. The following are further eligibility rules for horticultural lighting equipment:

- Products that are light engines (analogous to RP-16 section 6.8.5.5) or identified as retrofit kits intended to replace the light sources or other structures within an existing fixture are not eligible for qualification at this time.
- Fixtures that incorporate light sources other than LED, whether as sole-source or as LED-hybrid fixtures, are not eligible for qualification at this time.



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- Manufacturers must list full and complete model numbers that clearly demonstrate all qualified product options offered.
    - “Full and complete model numbers” means model numbers that include all performance-affecting and non-performance-affecting variations offered, and which do not omit any option that is available to customers in the market. In general, options that do not affect the performance of the product can be submitted as a single model number, and the multiple options can be denoted by bracketing them in the model number.

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For example, a product that has multiple exterior paint color options or mounting options that do not affect performance may include all color and mounting options in brackets (e.g. "[WH, BLK, SLV, GRY]") within a single model number. Low and high voltage options may be submitted as a single model number (e.g. "ABC 300 [120V-277V, 347V-480V] WH") with the worst-case performance reported. Multiple driver variations may be included in single product applications, as noted above, and listed in a single model number as long as they perform nominally the same. If the drivers perform nominally differently – that is, they are not presented to customers as having the same performance other than voltage input and result in different ordering codes – then the unique drivers must be listed in separate model numbers. Options that affect the flux output, presence or lack of dimming capabilities, or spectral tuning options cannot be bracketed and submitted as a single model number.

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    - DLC reviewers may check web listings and other marketing materials and reserve the right to request additional information to demonstrate the full and complete model number. A lack of clarity in model numbers will result in delayed application processing; misrepresentation of model numbers in the application process discovered outside the application process will generally be considered a violation of the DLC program and trademark rules.

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    - Each model number can only represent the fixture under a single brand. If the fixture can be sold under multiple brands, model numbers must be listed separately for each brand.

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## 55 Testing Methods and Requirements

56 The DLC Technical Requirements for LED-based Horticultural Lighting are as follows. Details explaining  
57 each item follow **Table 1**.

58 Table 1: DLC Horticultural Lighting Technical Requirements

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation
<b>Photosynthetic Photon Flux</b> ( $\Phi_p$ or PPF) ( $\mu\text{mol} \times \text{s}^{-1}$ )	n/a	Reported	(ANSI/IES LM-79) 400-700nm range, with 400-500nm, 500-600nm, and 600-700nm bins reported alongside the total
<b>Far-Red Photon Flux</b> ( $\Phi_{p,fr}$ or PPF <sub>FR</sub> ) ( $\mu\text{mol} \times \text{s}^{-1}$ )	n/a	Reported	(ANSI/IES LM-79) 700-800nm range
<b>Photon Flux</b> (PF <sub>PBAR</sub> ) ( $\mu\text{mol} \times \text{s}^{-1}$ )	n/a	Reported (Optional)	(ANSI/IES LM-79) 280-800nm range
<b>Spectral Quantum Distribution</b> (SQD) ( $\mu\text{mol} \times \text{s}^{-1} \times \text{nm}^{-1}$ )	n/a	Reported	(ANSI/IES LM-79) (ANSI/IES TM-33-18) 400-800nm range
<b>Photosynthetic Photon Intensity Distribution</b> (I <sub>p</sub> or PPID) ( $\mu\text{mol} \times \text{s}^{-1} \times \text{sr}^{-1}$ )	n/a	Reported	(ANSI/IES LM-79) (ANSI/IES TM-33-18) 400-700nm range
<b>Photosynthetic Photon Efficacy</b> (K <sub>p</sub> or PPE) ( $\mu\text{mol} \times \text{J}^{-1}$ )	$\geq 1.90 \mu\text{mol} \times \text{J}^{-1}$	Required/Threshold	(ANSI/IES LM-79) 400-700nm range
<b>Photon Efficacy</b> (PE <sub>PBAR</sub> ) ( $\mu\text{mol} \times \text{J}^{-1}$ )	n/a	Reported (Optional)	(ANSI/IES LM-79) 280-800nm range
<b>Photon Flux Maintenance, Photosynthetic</b> (PFM <sub>p</sub> )	Q <sub>90</sub> $\geq 36,000$ hours	Required/Threshold	(ANSI/IES LM-80 / IES TM-21 or IES LM-84 / IES TM-28) 400-700nm range, fixture technical specification sheet, and <i>In-Situ Temperature Measurement Test</i> (ISTMT)

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation
<b>Photon Flux Maintenance, Far-Red (PFM<sub>FR</sub>)</b>	Report time to Q <sub>90</sub>	Reported	(ANSI/IES LM-80 / IES TM-21 or IES LM-84 / IES TM-28) 700-800nm range
<b>Driver Lifetime</b>	≥50,000 hours	Required/Threshold	Driver technical specification sheet, fixture technical specification sheet, and <i>In-Situ Temperature Measurement Test</i> (ISTMT)
<b>Fan Lifetime</b>	≥50,000 hours	Required/Threshold	Fan technical specification sheet, fixture technical specification sheet
<b>Warranty</b>	5 years	Required/Threshold	Legal warranty terms & conditions
<b>Power Factor (PF)</b>	≥0.9	Required/Threshold	Benchtop electrical testing or ANSI/IES LM-79
<b>Total Harmonic Distortion, Current (THDi)</b>	≤20%	Required/Threshold	Benchtop electrical testing or ANSI/IES LM-79
<b>Safety Certification</b>	Horticultural Lighting designation by OSHA NRTL or SCC-recognized body	Required/Threshold	ANSI/UL 8800 (ANSI/CAN/UL 8800)

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60 **Output Characteristics:**

61 The DLC requires testing and reporting of the following characteristics for the output of horticultural  
62 lighting devices.

- 63 • **Photosynthetic Photon Flux (Φ<sub>p</sub> or PPF), (μmol × s<sup>-1</sup>)**

64 This is the total output of the product over the specific range of wavelengths defined by  
65 ANSI/ASABE S640 for PPF (400-700nm). This metric is an integrated value for the entire fixture  
66 and contains no spectral or directional information.

67 The DLC Horticultural QPL reports on both the total and ~100nm-wide “bins” of flux within this  
68 range to allow end users to understand the fixture’s relative proportions. Test information must  
69 provide output in these ranges specifically, in addition to the total 400-700nm output.



70 • **Far-Red Photon Flux ( $\Phi_{p,fr}$  or  $PF_{FR}$ ), ( $\mu\text{mol} \times \text{s}^{-1}$ )**

71 This is the output of the product over the “far-red” band defined by ANSI/ASABE S640 (700-  
72 800nm). This metric is an integrated value for the entire fixture and contains no spectral or  
73 directional information. This metric is reported only and does not have a qualifying threshold.

74 The DLC Horticultural QPL reports on the total flux of this 100nm-wide band separately for end  
75 users’ informational needs.

76 • **Photon Flux ( $PF_{PBAR}$ ), ( $\mu\text{mol} \times \text{s}^{-1}$ )**

77 This is the output of the product over a plant’s “photobiologically active radiation” (PBAR)  
78 wavelength range (280-800nm). This metric is an integrated value for the entire fixture and  
79 contains no spectral or directional information. This metric is optionally reported only and does  
80 not have a qualifying threshold.

81 The DLC Horticultural QPL reports on the total flux of this PBAR band specifically for end users’  
82 informational needs.  $PF_{PBAR}$  is intended to convey UV, PAR, and FR radiation, which are often  
83 associated with photomorphological effects in plants.  $PF_{PBAR}$  is not an ASABE S640 defined term  
84 and is not required for DLC qualification, though it can be reported and listed if desired by  
85 applicants.

86 • **Photon Efficacy ( $PE_{PBAR}$ ), ( $\mu\text{mol} \times \text{J}^{-1}$ )**

87 This is the output of the product over a plant’s “photobiologically active radiation” (PBAR) band  
88 (280-800nm) divided by the total electrical input watts to the fixture, including any other  
89 ancillary loads (controllers, sensors, cooling fans, etc.) used within the lighting system. This  
90 metric is an integrated value for the entire fixture and contains no spectral or directional  
91 information. This metric is optionally reported only and does not have a qualifying threshold.

92 The DLC Horticultural QPL reports on the total flux of this PBAR band specifically for end users’  
93 informational needs.  $PE_{PBAR}$  is intended to convey luminaire efficacy in converting electrical  
94 energy into UV, PAR, and FR radiation, which are often associated with photomorphological  
95 effects in plants.  $PE_{PBAR}$  is not an ASABE S640 defined term and is not required for DLC  
96 qualification, though it can be listed if desired by applicants.

97 • **Spectral Quantum Distribution (SQD), ( $\mu\text{mol} \times \text{s}^{-1} \times \text{nm}^{-1}$ )**

98 This is the distribution of photon flux per photon wavelength over the photosynthetic and far-  
99 red range of wavelengths defined by ANSI/ASABE S640 (400-800nm). The DLC will also accept  
100 the distribution of photon flux per photon wavelengths over the PBAR range (280-800nm).  
101 When reporting either of the optional PBAR metrics (i.e.  $PF_{PBAR}$  and  $PE_{PBAR}$ ), distribution of  
102 photon flux over the PBAR range is required. This distribution is measured and reported as  
103 integrated in all directions from the fixture and contains no granular directional information  
104 itself. This distribution must be measured and reported from an appropriately accredited  
105 facility.

106 An image of this distribution must be submitted within the application in a .jpg graphical file  
107 format, at a size of 300x300 pixels or larger. This image will be accessible to users on the QPL.  
108 The DLC intends to utilize the required .xml file per ANSI/IES TM-33-18 to generate these images  
109 in the future.

110 Please refer to the [TM-33-18 Reporting and Photometric/Spectral Reporting Alternatives](#) section  
111 for additional information.

112 • **Photosynthetic Photon Intensity Distribution ( $I_p$  or PPID), ( $\mu\text{mol} \times \text{s}^{-1} \times \text{sr}^{-1}$ )**

113 This is the distribution of photosynthetic photon intensity per unit solid angle leaving the fixture.  
114 This distribution is measured and reported as integrated for all wavelengths across the 400-  
115 700nm range leaving the fixture and contains no spectral distribution information itself. This  
116 distribution must be measured and reported from an appropriately accredited facility.

117 An image of this distribution is to be submitted within the application in a .jpg graphical file  
118 format, at a size of 300x300 pixels or larger. This image will be accessible to users on the QPL.  
119 The DLC intends to utilize the required .xml file per ANSI/IES TM-33-18 to generate these images  
120 in the future.

121 Please refer to the [TM-33-18 Reporting and Photometric/Spectral Reporting Alternatives](#) section  
122 for additional information.

123 *Note: The DLC will no longer accept distribution data that are developed through in-house*  
124 *assessments. Products that were qualified prior to the V2.0 effective date must provide TM-33-*  
125 *18 documents by December 31, 2021 to requalify to the V2.0 Technical Requirements, or the*  
126 *products will be delisted.*

127 **Efficacy:**

128 The DLC requires testing and reporting of Photosynthetic Photon Efficacy (PPE), which is the output of  
129 the fixture over the specific range of wavelengths defined by ANSI/ASABE S640 for PPF (400-700nm),  
130 divided by the total electrical input watts to the fixture, including any other ancillary loads (controllers,  
131 sensors, cooling fans, etc.) used within the lighting system.

132 All products are required to have a PPE of  $\geq 1.90 \mu\text{mol} \times \text{J}^{-1}$ . In both submitted applications and under  
133 surveillance testing, the DLC allows an absolute tolerance of -5% to this threshold value. The result of  
134 this is the DLC's acceptance of any test report showing an efficacy of  $1.81 \mu\text{mol} \times \text{J}^{-1}$  or higher, and the  
135 disqualification of any product, either during submission or surveillance testing, with a test report  
136 showing an efficacy less than  $1.81 \mu\text{mol} \times \text{J}^{-1}$ , at any point in the product's specified operating voltage  
137 range. All evaluations and listings of this measurement will be rounded to the nearest hundredth.

138 If a product contains multiple drivers:

- 139 • All driver specification sheets must be provided.
- 140 • For each unique driver used, manufacturers must provide electrical testing to document which  
141 driver variation results in the overall minimum  $K_p$  (PPE) or worst-case driver efficiency, as well as  
142 which variation results in the overall worst-case power quality (THDi and PF).
  - 143 ○ This testing must include the input current and wattage; the output voltage, current,  
144 and wattage; and the THDi and PF for each driver, at each nominal input voltage.
  - 145 ○ In-house (i.e. non-accredited lab) benchtop electrical testing is sufficient for  
146 demonstrating the driver variation that yields the overall minimum  $K_p$  (PPE) and

- 147 minimum power quality at the applicable loading conditions and at the applicable input  
148 voltages.
- 149 ○ From this electrical characterization testing, the product and conditions representing  
150 worst-case efficacy must undergo formal whole-fixture LM-79 testing by an accredited  
151 testing lab.
  - 152 ○ For questions about testing requirements for family grouping applications, please refer  
153 to the [Family Grouping Application Requirements for LED-based Horticultural Lighting](#)  
154 [policy](#).
  - 155 ● Drivers that result in explicitly different nominal fixture performance (for example, if a driver  
156 change results in different flux output by the product, determined at the DLC's discretion) are  
157 not permissible variations within a single model number and are required to submit a family  
158 grouping application for QPL listing. If alternate driver variations result in different input  
159 wattage, worst-case will be published on the QPL.
    - 160 ○ Please refer to the [Family Grouping Application Requirements for LED-based](#)  
161 [Horticultural Lighting policy](#) for specific testing and reporting requirements for product  
162 families.

### 163 Long-Term Performance:

164 The DLC requires the following performance data to characterize the long-term performance of the  
165 fixture:

- 166 ● **Flux Maintenance,  $\Phi_p$  (PPF) and  $\Phi_{p,fr}$  (PF<sub>FR</sub>)**

167 This is a characterization of the ability of the device to maintain its output within the given  
168 parameters over time. Given that device output of interest is measured in quanta of photons,  
169 and not in lumens, the DLC will use the general engineering term for quanta, "Q", instead of the  
170 more-familiar "L" prefix used within general illumination applications.

  - 171 ○ The DLC requires either LED device-level or whole-fixture testing and projections in  
172 accordance with the (LM-80 and TM-21) or (LM-84 and TM-28) industry standards  
173 sufficient for a Q<sub>90</sub> of ≥36,000 hours within the  $\Phi_p$  (PPF) range (400-700nm).
    - 174 ■ The "Q" in the Q<sub>90</sub> value is based strictly on the value shown in cell I42 of the  
175 ENERGY STAR [TM-21 calculator](#) or cell I45 of the ENERGY STAR [TM-28 calculator](#).
  - 176 ○ All TM-21 or TM-28 projections must be made at the maximum ambient temperature on  
177 the fixture's specification sheet. See [In-Situ Temperature Measurement Testing \(ISTMT\)](#)  
178 information below for additional details.
  - 179 ○ The DLC requires testing and projections to report Q<sub>90</sub> for the  $\Phi_{p,fr}$  (PF<sub>FR</sub>) range of 700-  
180 800nm, but does not make determinations or qualifications based on this data. Please  
181 see a description of PFM<sub>FR</sub>-specific testing requirements in the "[For fixtures using](#)  
182 [multiple types of LEDs](#)" section below.
  - 183 ○ To support PFM<sub>P</sub> and PFM<sub>FR</sub> projections, LM-80/LM-84 information must be provided for  
184 both the 400-700nm and the 700-800nm range.

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- All new product submissions using the LM-80/TM-21 approach are required to provide LM-80 data in appropriate (PPF,  $PF_{FR}$ ) units, measured as such at all time points in the LM-80 procedure. The DLC reserves the right to request additional information for all reports referring to “photon flux” that are ambiguous (based on product SQD) about the division of said flux between the PPF and  $PF_{FR}$  categories to determine approval.
    - Products qualified with non-PPF units that were converted into PPF units during the provisional period (i.e. prior to V1.2) will be required to provide LM-80 data in appropriate units to requalify under the V2.0 Technical Requirements.
    - Provisionally qualified products will be allowed to update their listings to remove any caveats by submitting actual data by December 2021. The DLC will process these update applications through the month of December, 2021.
  - Products may not be qualified and listed on the QPL without long-term performance data for flux degradation. Products that use LEDs for which no LM-80 data is available are required to undergo LM-84 testing for TM-28 projections.
  - *In-Situ Temperature Measurement Testing (ISTMT):*
    - ISTMTs must be conducted and provided for the hottest LED in the fixture, and LED-device level drive current must be reported.
    - ISTMTs must be conducted and reported in the same manner as thermal testing for safety certification. Specifically, applicants must report the operating temperature of the LED at the fixture’s highest rated ambient temperature within the ISTMT report. This must be done in accordance with acceptable procedures from safety certification standards for measuring and projecting operating temperatures. For example, if a fixture is rated for operation at 40°C ambient, ISTMTs are not accepted if they only show the temperature of the LED when measured during a 25°C ambient condition. In this example, appropriate steps must be taken to characterize the LED operating temperature when the fixture is in a 40°C ambient environment, as defined by the thermal portions of the relevant safety standards.
  - For fixtures using multiple types of LEDs:
    - LM-80 reports (if being used instead of whole-fixture LM-84 data) must be provided for each type of LED device present in the fixture.
      - For DLC evaluations, LED “type” is differentiated by the nominal output of the LED device or the manufacturer of that LED device. For example, a fixture incorporating four different LEDs, with nominal emissions of 440nm, 660nm, 730nm, and a 5000K “white”, is required to provide four LM-80s and associated information for TM-21 projections, corresponding to each of these nominal designations. Some limited



226 cross-applicability of LM-80 data is allowed within phosphor-converted  
227 white LEDs of the same series; see [LM-80 applicability](#) information  
228 below.

- 229       ▪ ISTMT testing must be provided on the hottest of each LED type (for example,  
230 the hottest blue, white, and red LED in the fixture, respectively).
- 231       ▪ Maximum LED drive current must be reported for each LED type.
- 232       ▪ For PFM<sub>p</sub> (400-700nm), each LED type present in the fixture that has at least  
233 25% of its per-device flux in the PPF range must independently meet the Q<sub>90</sub> ≥  
234 36,000 hours requirement, as shown by a TM-21 calculation. The DLC does not  
235 require device-level SQD data from applicants and will typically accept the  
236 applicant’s descriptions of a device’s relative PPF while reserving the right to  
237 request explanation.
- 238       ▪ The DLC requires calculated PFM<sub>FR</sub> for all fixtures with a PFM<sub>FR</sub> output that is equal  
239 to or greater than 5% of the fixture’s flux from 400-800nm. For PFM<sub>FR</sub> (700-  
240 800nm), each LED type present in the fixture that has at least 25% of its per-  
241 device flux in the PFM<sub>FR</sub> range must report its Q<sub>90</sub> duration in hours. The DLC does  
242 not require device-level SQD data from applicants and will typically accept the  
243 applicant’s descriptions of a device’s relative PFM<sub>FR</sub>, while reserving the right to  
244 require explanation. There is no threshold performance requirement across this  
245 far-red range; it is a reported value only.

246 ○ LM-80 applicability:

- 247       ▪ For phosphor-converted “white” LEDs within the ANSI nominal chromaticity  
248 range, the DLC follows the [ENERGY STAR Requirements for the Use of LM-80](#)  
249 [Data](#) published September 2017. Consistent with the ENERGY STAR  
250 requirements, for narrow-band emitters, the DLC generally requires an LM-80  
251 for each distinct nominal product offered by an LED device manufacturer.  
252 Devices of the same type but with different optical codes for beam spread are  
253 allowed to cross-apply LM-80 testing. This also applies to products that are in  
254 the same series with differences in nomenclature due to marketing changes  
255 (see series provisions of ENERGY STAR requirements document). The DLC  
256 reserves the right to require additional information to approve all claims of LM-  
257 80 applicability.

258 ● **Warranty**

259 Products must have a manufacturer-provided product warranty of at least five years. The  
260 warranty terms and conditions must be provided as part of the submittal for qualification. The  
261 warranty must cover the complete luminaire and must clearly explain the terms and conditions  
262 associated with the warranty. Note that “luminaire” includes light source, housing, heat sink,  
263 power supplies, and other electrical components, optics, and any other components such as  
264 cooling fans or controls (if present).

265 Warranty terms and conditions can vary widely from manufacturer to manufacturer. The DLC  
266 explicitly defines a warranty period of five years and does not have specific requirements for

267 warranty claim terms (e.g. labor, recommissioning, etc.) other than those listed above. The DLC  
268 does not verify or validate a manufacturer’s terms, conditions, or process for customer warranty  
269 claims. The DLC does not monitor field failure rates of qualified products or warranty policy  
270 redemption or history among manufacturers. Industry stakeholders are urged to review  
271 warranty terms and conditions as part of the purchasing decision process.

- 272 • **Driver ISTMT**

273 Applicants must supply a technical specification sheet for the driver(s) they use in their product,  
274 showing the lifetime of the driver based on operating temperature and the temperature  
275 measurement point (TMP) for monitoring the operating temperature of the driver. In-situ  
276 temperature measurement testing must be conducted, and a report must be provided with the  
277 application showing an operating temperature consistent with the driver specification sheet  
278 information and demonstrating that the driver will have a lifetime of at least 50,000 hours when  
279 operating at or above the highest rated ambient temperature on the fixture’s specification  
280 sheet.

281 As noted in the [ISTMT](#) description within the flux maintenance section, driver ISTMTs must be  
282 conducted and reported in the same manner as thermal testing for safety certification.  
283 Specifically, applicants must report the operating temperature of the driver at the fixture’s  
284 highest rated ambient temperature within the ISTMT report. This must be done in accordance  
285 with acceptable procedures from safety certification standards for measuring and projecting  
286 operating temperatures. For example, if a fixture is rated for operation at 40°C ambient, ISTMTs  
287 are not accepted if they only show the temperature of the driver when measured during a 25°C  
288 ambient condition. In this example, appropriate steps must be taken to report the driver  
289 operating temperature when the fixture is operating in a 40°C ambient environment, as defined  
290 by the thermal portions of the relevant safety standards.

- 291 ○ For products that may use multiple drivers, specification sheets for each driver must be  
292 provided with the details above. Testing must be conducted on each driver at its  
293 appropriate worst-case input voltage. If a product uses multiple drivers from the same  
294 manufacturer product line or series, then the single worst-case thermal ambient  
295 environment of the product line or series requires a driver ISTMT. The DLC will operate  
296 with the expectation that the operating condition at the highest wattage in the driver  
297 manufacturer’s product line or series is the worst-case thermal ambient environment,  
298 but the DLC may ask the manufacturer to provide detailed evidence to document the  
299 worst-case driver thermals.

- 300 • **Fans**

301 Products that employ on-board cooling fans must provide a technical specification sheet for  
302 each fan type employed in the product, family group, or spectral sub-group, as applicable. The  
303 fan specification sheet must state the lifetime of the fan and a reference operating temperature  
304 rating for that lifetime claim. The lifetime must be at least 50,000 hours, at an operating  
305 temperature at or above the fixture’s highest rated ambient temperature.

306 If the product is available with multiple fan models:

- 307 ○ If fan model variations result in substantively different component temperature or  
308 wattage consumption by the fixture (determined at the DLC's discretion), a family  
309 grouping application is required with model numbers to represent the different fan  
310 variations. DLC reviewers will examine fan model power levels and flow rate to  
311 determine this distinction. Products that offer fan variations without substantively  
312 different component temperature or wattage consumption by the fixture are allowed to  
313 qualify using bracketed variations within a single model number.
- 314 ○ Multiple fan variations require a similar testing and reporting plan to multiple driver  
315 variations, as noted in the efficacy section.

### 316 **Electrical Performance/Power Quality:**

317 The DLC requires testing and reporting of the following items to characterize the electrical performance  
318 of the fixture:

- 319 • **Power Factor**  
320 Products must have a measured power factor of  $\geq 0.90$  at any rated input voltage at full output  
321 or non-dimmed state.
- 322 • **Total Harmonic Distortion, current (THDi)**  
323 Products must have a measured THDi of  $\leq 20\%$  at any rated input voltage at full output or non-  
324 dimmed state.

325 For products with driver variations, including input voltage variations, electrical testing of each product  
326 must be performed, sufficient to characterize the power quality of each driver, at its applicable nominal  
327 input voltages and maximum designed output power. Testing to demonstrate that products are  
328 compliant with the power factor and total harmonic distortion requirements may be done on an in-  
329 house or benchtop setup for practical simplicity, and results must be documented and included in the  
330 application materials. Please see the efficacy section regarding the use of this electrical testing for  
331 worst-case efficacy driver variation determination. Please refer to the [Family Grouping Testing](#)  
332 [Requirements for LED-based Horticultural Lighting policy](#) for specific testing and reporting requirements  
333 for product families.

### 334 **Safety:**

335 Products must be certified by an OSHA NRTL or SCC-recognized body to ANSI/UL 8800 (ANSI/CAN/UL  
336 8800) which is applicable for *horticultural lighting products* by that safety organization.

337 For illustrative and reference purposes, practices of acceptable safety organizations are described  
338 below:

- 339 • **UL**  
340 Fixture manufacturers who use UL for safety certification purposes are required to be listed on  
341 the UL Certification Directory under the designation IFAU.

- 342 • **ETL/Intertek**  
343 Fixture manufacturers who use ETL for safety certification are required to be listed on the ETL  
344 Certification Directory, specifically as Horticultural Fixtures.
- 345 • **CSA Group**  
346 Fixture manufacturers who use CSA for safety certification are required to be listed under CSA  
347 Group's Classes defined for horticultural lighting equipment in Canada and the US.
- 348 • **TÜV SÜD**  
349 Fixture manufacturers who use TÜV SÜD for safety certification are required to be listed on the  
350 TÜV SÜD Certification Directory, specifically as a light fixture for use on horticulture purposes.
- 351 • **SGS**  
352 Fixture manufacturers who use SGS for safety certification are required to be listed on the SGS  
353 Certification Directory, specifically as horticultural lighting equipment.
- 354 • **Other safety organizations**  
355 To be added to the DLC's approved list of safety organizations who certify horticultural lighting  
356 equipment per ANSI/CAN/UL 8800 requirements, please contact [horticulture@designlights.org](mailto:horticulture@designlights.org).

## 357 **Special Considerations**

### 358 **Special Considerations for Spectrally-Tunable Products**

359 Spectrally-tunable products (those with varying output channels beyond simple, single-axis dimming of  
360 the whole product) are eligible with the following conditions:

- 361 • The threshold-qualifying state to be tested must be the manufacturer-designed state with the  
362 highest power consumption ("maximum power"). This may or may not be the same as an "all  
363 channels on" condition, since fixtures may not be designed to use all their channels  
364 simultaneously. Test reports must specifically indicate that the product is operated in this  
365 "maximum power" condition during the testing, with a description of the control narrative to  
366 ensure that the power state is at its maximum designed level.
- 367 • In addition to the "maximum power" condition, applicants must perform PPF testing for each  
368 control channel, in which the channel under test must be set to the maximum designed output,  
369 while all other channels must be set to their minimum designed output for this state. The test  
370 report must present an identifying name of this channel and setting, the PPF (400-700nm total  
371 and 400-500nm, 500-600nm, and 600-700nm "bins" PPF) and  $PF_{FR}$  (700-800nm) for each of the  
372 single-channel scenarios, and a description of the control narrative to achieve each setting. For  
373 each channel tested, a corresponding graphic for the SQD produced in that setting must be  
374 provided in the application. Refer to the SQD section for reporting requirements.
  - 375 ○ The flux output of each specific channel testing is displayed on the DLC Horticultural  
376 QPL, with the per-channel test outcomes and identifying information for each setting.  
377 These data are intended to support standardized communication of information about  
378 the product's spectral tuning range, aiding product selection and user acceptance.

- 379 • Applicants must provide user-facing documentation narrating the control protocol and input  
380 parameters employed in controlling the output.
- 381 • For PFM<sub>P</sub> and PFM<sub>FR</sub> evaluation:
  - 382 ○ Provisions for products utilizing multiple types of LEDs must be followed as described in  
383 the [For fixtures using multiple types of LEDs](#) section.
  - 384 ○ ISTMT testing must be provided on the hottest of each of the LED types. For each  
385 unique LED type, ISTMT testing must occur at the operating mode that produces the  
386 highest operating temperature in the fixture, for this LED type.
  - 387 ○ The DLC asks any applicants considering LM-84-based maintenance testing on a  
388 spectrally-tunable fixture to contact [horticulture@designlights.org](mailto:horticulture@designlights.org) to discuss their  
389 proposed testing plan.

## 390 PROPOSED Special Considerations for DC-Powered Fixtures

### 391 Eligibility Information

392 Horticultural lighting fixtures powered by direct current (DC) are eligible for listing on the Horticultural  
393 QPL. DC-powered fixtures include two types:

- 394 • **Modular fixtures where one AC-to-DC power source supplies power to multiple fixtures.** The  
395 power source may have a minimum as well as a maximum number of fixtures that it may serve.  
396 The AC-to-DC power source may be attached to one of the fixtures or may be located remotely  
397 from the fixtures. The fixtures may be offered with more than one power supply option. The  
398 power source must be available to purchase through the fixture manufacturer for that specific  
399 fixture model or family.
- 400 • **Fixtures that operate on DC power, where one or more AC-to-DC power source may or may**  
401 **not be sold with the fixture.** These fixtures may be wired to an AC-to-DC power source outside  
402 the fixture or in a separate room, or may be part of an off-grid, DC-only horticulture facility.

### 403 Technical Requirements Information

404 All V2.0 Horticultural Lighting Technical Requirements described in **Table 1** must be met in addition to  
405 the following requirements.

406 The following requirements apply to applications for DC-powered fixtures, in place of the equivalent AC  
407 testing and reporting:

- 408 • **DC-Powered “All-on” Photon Flux Test Report:** Applicants must provide an LM-79 report in PDF  
409 format from an accredited third-party test lab with all required photon flux and power values for  
410 verification, including DC voltage, current and power. For dimmable or tunable products, this is  
411 the test report of the product at its maximum (non-dimmed) power state. Additionally, to better  
412 capture worst-case operating conditions, including losses over cabling, LM-79 testing must be  
413 conducted while using the longest cabling option allowed if specified by the fixture  
414

415 manufacturer. Performance measurements shall be made at the cabling input so that losses  
416 over the length of the cabling are included in LM-79 measurements.

417 • **Tested Power Source Report:** For both types of DC-powered fixtures, if power sources are  
418 offered for sale with the DC-powered fixture, applicants must provide a table of the following  
419 performance values for all drivers offered for sale with the DC fixture. A power source  
420 specification sheet or other documentation from the power source manufacturer with  
421 numerical values listed for each load point may satisfy this requirement, in place of testing.  
422 These values may come from benchtop testing (measurements performed by a manufacturer  
423 that are not from a certified testing lab). All values must be provided at the minimum and  
424 maximum AC input voltages for each driver, as well as at each DC output voltage utilized by the  
425 DC-modular fixture (if multiple).

426 ○ Performance values must be provided at each of four load points:

- 427 ■ The driver's maximum rated power load
  - 428 ■ 50% of maximum load
  - 429 ■ 20% of maximum load
  - 430 ■ The minimum power source load if specified by the fixture manufacturer
- 431 – For example: The minimum driver load is the load represented by one  
432 fixture, e.g. 30% load for a 100W power source that may power one to  
433 three 30W fixtures, or by the minimum number of fixtures per power  
434 source specified on the fixture spec sheet, e.g. 60% load for a 100W  
435 power source that may power either two or three 30W fixtures.

436 ○ Performance values to be reported in the benchtop test report:

- 437 ■ Consumed input power, shown to the nearest hundredth of a watt
- 438 ■ DC output power, shown to the nearest hundredth of a watt
- 439 ■ Electrical efficiency (driver power output divided by driver power consumed),  
440 shown to the nearest hundredth
- 441 ■ Power factor, shown to three significant digits
- 442 ■ Total harmonic distortion of the current waveform as a percentage, shown to  
443 three significant digits at minimum

444 ○ The following example shows this table for a single power supply:

Manufacturer Name		Model Number		AC Input Voltage Range (V)		DC Output Voltage Range (V)	
ABC Corp.		ABC123		120-277		48V	
Input Voltage (V)	Output Power Range (W)	Loading Percentage	Input Power (W)	Tested Output Power (W)	Tested Efficiency (%)	Power Factor	Total Harmonic Distortion (current)
120	30-300	100%	315.2	300	95.18	0.932	0.05
		50%	161.1	150	93.11	0.928	0.041
		20%	65.9	60	91.05	0.911	0.04
		minimum %	35.1	30	85.47	0.908	0.038
277	30-300	100%	314.8	300	95.30	0.932	0.05
		50%	160.9	150	93.23	0.928	0.041
		20%	65.5	60	91.60	0.911	0.04
		minimum %	36.2	30	82.87	0.908	0.038

452 ○ Fixtures that are not offered for sale with any AC-to-DC power source are not required  
 453 to provide a tested driver report. These products will be listed with an assumed AC-to-  
 454 DC conversion efficiency—see below.

455 • Consistent with the Horticultural Technical Requirements, Driver ISTMT Reports are required for  
 456 all horticultural products sold with AC-to-DC or DC-to-DC power sources.

457 ○ Fixtures that are not offered for sale with any AC-to-DC power source are not required  
 458 to provide a Driver ISTMT report.

### 459 QPL Listing Information

460 DC-powered fixtures will be listed on the Horticultural Lighting QPL with the following differences from  
 461 AC-powered fixtures:

462 • New fields will be reported:

463 ○ “System Type” will be distinguished between AC and DC products.

464 ○ “DC Input Voltage” and “DC Input Current”, from DC-powered LM-79 for both DC-  
 465 powered fixture types.

466 ○ “DC Input Power” and “DC Photosynthetic Photon Efficacy: 400-700 nm,  $\mu\text{mol}/\text{J}$  (DC  
 467 PPE)” will display the values from the all-on DC photon flux report.

468 ■ Optional new field “DC PE<sub>PBAR</sub>” will be reported if PE<sub>PBAR</sub> is reported.

469 ○ Additionally, new fields will display “AC De-rated Input Power” and “AC De-rated PPE”  
 470 only for DC-powered fixtures.

471 ■ DC-powered fixtures offered for sale with any AC-to-DC power source will  
 472 reflect the power efficiency of the AC-to-DC conversion at the load condition  
 473 that creates the worst-case efficiency. For example, a 100W lightbar with PPE of  
 474 2.5 and a power supply showing a worst-case efficiency of 85% at 20% load,  
 475 would be listed on the QPL at 2.13 $\mu\text{mol}/\text{J}$  and 118W.

476 ■ DC-powered fixtures that are not offered for sale with any AC-to-DC power  
 477 source will display values in the AC de-rated fields based on an assumed 87.5%

478 conversion efficiency. 87.5% is informed by the Federal Standard per 10 C.F.R. §  
479 430.32(w) for minimum efficiency for External Power Supplies greater than  
480 250W.

481       ▪ Optional new field “AC De-rated  $PE_{PBAR}$ ” will be reported if  $PE_{PBAR}$  is reported.

482 • The fields currently used for “AC Input Power” and “AC PPE” will not be populated.

483 • The worst-case values of THD and Power Factor will be shown in the existing fields.

## 484 **Key Questions for V2.1 Draft 1, DC-Powered Fixtures**

485 1. Is the proposed method for listing de-rated values for fixtures offered for sale with one or more  
486 power sources appropriate? Should any other information (beyond power draw at the worst-  
487 case load condition) be displayed on the Hort QPL to assist QPL users? Is the 87.5% conversion  
488 efficiency the right assumption?

489 2. Is the proposed method for listing de-rated values for fixtures not offered for sale with any  
490 power source appropriate?

491 3. Is it beneficial to list de-rated AC values for Input Power and PPE, in addition to DC values? Are  
492 AC values for a worst-case configuration useful in evaluating proposed hort lighting systems? Or  
493 are system evaluators, such as custom incentive program engineers, more likely to use  
494 manufacturer-provided information to calculate power and PPE at the actual load conditions,  
495 driver configuration, and input voltage of the system under consideration?

496 4. Are the power source performance data required for the table available from power source  
497 manufacturers?

498 5. If no maximum cabling length is specified at the luminaire level, how could worst-case power  
499 losses over cabling be considered during LM-79 testing? If cabling gauge varies to account for  
500 longer cabling, should higher gauge, longer cable runs or lower gauge, shorter cables runs be  
501 tested?

502 6. The proposed requirements would offer no information on power source efficiency below 20%  
503 load condition. Is it important to capture power source efficiency below 20% loading, and if so  
504 where does this load condition exist in horticultural lighting applications? What minimum  
505 loading percentage would reflect this real-world use for AC-de-rated reporting?

506  
507



## 508 PROPOSED Special Considerations for Externally-Supplied Actively Cooled 509 Fixtures

### 510 Eligibility Information

- 511 • LED horticultural fixtures that employ externally-supplied ducted forced-air are not eligible. LED  
512 horticultural fixtures that employ externally-supplied circulating-liquid are eligible with the  
513 following conditions described below.
- 514 • The DLC defines externally-supplied circulating-liquid cooled horticultural fixtures to be products  
515 in which liquid, often water or a water/glycol solution, flows through input and output ports of  
516 each fixture in the system, being channeled through a cooling plate or other heat exchanger  
517 within the fixture.

### 518 519 Technical Requirements Information

- 520 • All V2.0 Horticultural Lighting Technical Requirements described in **Table 1** must be met in  
521 addition to the following requirements and clarifications:
  - 522 ○ Manufacturers must specify the range of allowable operating conditions that should be  
523 supplied to or affect the LED product performance, including:
    - 524 ▪ Solution type/concentration
    - 525 ▪ Flow rate
    - 526 ▪ Inlet fluid temperature
  - 527 ○ The threshold-qualifying state to be tested must be the manufacturer designated state  
528 with the *worst-case* operating conditions for inlet fluid temperature, flow rate, and  
529 solution concentration.
    - 530 ▪ Average and highest inlet fluid temperature, measured at the manufacturer  
531 specified Test Measurement Location (TML), must be measured and reported  
532 during ISTMT and LM-79 testing.
    - 533 ▪ ISTMT reports must report the operating temperature(s) at the fixture's highest  
534 rated ambient temperature.
  - 535 ○ Inlet fluid temperature must also be measured and reported during benchtop electrical  
536 testing.
  - 537 ○ To support the qualification of *externally-supplied* circulating-liquid cooled horticultural  
538 fixtures, the DLC will accept LM-79 gonioradiometer testing with methods or equipment  
539 from other gonioradiometer types in addition to Type C.
    - 540 ▪ All *externally-supplied* circulating-liquid cooled horticultural fixtures seeking  
541 qualification by the DLC must test the fixture per ANSI/IES LM-79, including  
542 requirements specific to, but not limited to, stabilization and optical  
543 measurements, while employing active cooling.

- 544 ○ Electrical testing must be provided to document the maximum input power and input  
545 voltage to the externally-supplied cooling mechanism when operating at the highest  
546 voltage in an “All On” (i.e. max flow rate, highest fluid temperature, etc.) state.
- 547     ▪ In-house (i.e. non-accredited lab) benchtop electrical testing is sufficient.
- 548 ○ Additionally, applicants must provide documentation describing the *externally-supplied*  
549 cooling mechanism with the following reporting and threshold requirements:
- 550     ▪ Rated lifetime of the cooling system must be a minimum of 10 years, as stated  
551 on the cooling mechanism manufacturer’s specification sheet.
- 552     ▪ Range of acceptable inlet and outlet fluid temperature, flow rate, and solution  
553 type/concentration must be defined.

### 554 QPL Listing Information

555 In addition to the existing fields, *externally-supplied* actively cooled fixtures will have the following  
556 information listed on the QPL:

- 557 • **“Product Category”**
  - 558 ○ *Externally-Supplied* circulating-liquid horticultural fixture
- 559 • **“Tested Inlet Fluid Temperature”**
  - 560 ○ Maximum and average measured temperature per ISTMT and LM-79 testing
- 561 • Allowable operating conditions supplied to fixture including:
  - 562 ○ **“Solution Concentration”**
  - 563 ○ **“Flow Rate Range”**
  - 564 ○ **“Inlet Fluid Temperature Range”**
- 565 • Per cooling mechanism in-house benchtop electrical test report:
  - 566 ○ **“Maximum Input Voltage”**
  - 567 ○ **“Maximum Input Power”**
  - 568 ○ **“Power Factor”**
  - 569 ○ **“Total Harmonic Distortion (current)”**

### 571 Key Questions for V2.1 Draft 1, Externally-Supplied Actively Cooled Fixtures

- 572 1. The DLC has proposed that *externally* supplied circulating-liquid horticultural fixtures meet the  
573 same efficacy requirements as V2.0 luminaires without considering power consumption of the  
574 cooling system. Should the power consumed by the cooling system be considered in evaluation  
575 of luminaire PPE? If so, how should it be considered and reported on the QPL?

- 576 2. The DLC has proposed a rated lifetime requirement of 10 years for the cooling system. Is the  
577 proposed rated lifetime requirement reasonable?
- 578 3. How does the rated input power for an externally-supplied cooling system differ when  
579 considering environment? i.e. Is performance substantially different if located within a  
580 greenhouse or set outside a grow facility? Is benchtop testing needed to consider “worst-case”  
581 conditions for the cooling system?
- 582 4. What, if any, additional considerations should be made for listing eligibility of *externally-*  
583 supplied circulating-liquid cooled horticultural fixtures?

## 584 **PROPOSED Special Considerations for LED Replacement Lamps**

### 585 **Eligibility Information: Linear Replacement Lamps**

586 LED replacements for linear fluorescent lamps are eligible with the following conditions:

- 587 • LED replacements for linear fluorescent lamps seeking qualification to the DLC Horticultural  
588 Lighting QPL must meet the definitions, eligibility requirements, supporting documentation, and  
589 distribution requirements of the [SSL V5.1 Testing and Reporting Requirements for Linear  
590 Replacement Lamps](#).
  - 591 ○ Linear replacement lamps seeking horticulture lighting qualification *do not* need to  
592 meet the following performance criteria under the solid-state lighting program:
    - 593 ▪ Luminous efficacy (lumens per Watt)
    - 594 ▪ Initial bare lamp light output (lumens)

### 595 **Technical Requirements Information: Linear Replacement Lamps**

- 596 • Linear replacement lamps seeking horticultural lighting qualification must test the bare lamp  
597 according to LM-79 to meet all V2.0 Horticultural Lighting Technical Requirements as described  
598 in **Table 1**.
  - 599 ○ The DLC defines bare lamp as the performance characteristics of a replacement lamp,  
600 including the effects of an external ballast (for Type A and Dual Mode lamps) or driver  
601 (for Type C lamps), if applicable, when operated outside of a luminaire or retrofit kit.

### 602 **Eligibility Information: Screw-Base Replacements for HID Lamps**

603 LED replacements for mogul-base high intensity discharge (HID) lamps are eligible with the following  
604 conditions:

- 605 • The DLC accepts Horticultural QPL applications for mogul (E39 and E40) screw-base replacement  
606 lamps. UL Type B products, which require removal of the existing ballast from the circuit and the  
607 lamp holder to be wired with line voltage, are eligible.
  - 608 ○ Other base types and UL Types are not eligible at this time.

- 609 ○ [Field-adjustable light distribution products](#) are not eligible at this time.
- 610 ● Screw-base LED replacements for HID lamps seeking qualification to the DLC Horticultural  
611 Lighting QPL must meet the definitions, eligibility requirements, and supporting documentation  
612 requirements of the [SSL Testing and Reporting Requirements for Screw-Base Replacements for](#)  
613 [HID Lamps](#).
  - 614 ○ Screw-base replacements for HID lamps seeking horticultural lighting qualification *do*  
615 *not* need to meet the following performance criteria under the solid-state lighting  
616 program:
    - 617 ■ In-Luminaire minimum efficacy (lumens per Watt)
    - 618 ■ In-Luminaire light output (lumens)
    - 619 ■ Reference Housing requirements
  - 620 ○ ISTMT testing shall be conducted similarly to the [SSL V5.1 Linear Replacement Lamp](#)  
621 [policy](#).

#### 622 **Technical Requirements Information: Screw-Base Replacements for HID Lamps**

- 623 ● Screw-base replacements for HID lamps seeking horticultural lighting qualification must test the  
624 bare lamp according to LM-79 to meet all V2.0 Horticultural Lighting Technical Requirements as  
625 described in **Table 1**.
- 626 ● Screw-base replacements for HID lamps must be generally omni-directional (the DLC defines  
627 omni-directional to be a product that emits radiation in all directions except in the base  
628 direction).

#### 629 **QPL Listing Information: All Replacement Lamps**

630 In addition to existing fields, replacement lamps will have the following information listed on the  
631 Horticultural Lighting QPL:

- 632 ● **“Product Category”**
  - 633 ○ Options include: Linear Replacement Lamp or Screw-Base Replacements for HID Lamps
- 634 ● **“Base Type”**
  - 635 ○ Options include: G13, G5, E39, E40
- 636 ● **“Product Size Information”**
  - 637 ○ Linear replacement lamps must include the nominal length in inches
  - 638 ○ Screw-base replacements for HID lamps must include product dimensions as Maximum  
639 Overall Length (including base) x width x height
- 640 ● **“UL Type”**
  - 641 ○ Options include: A, B, AB, C

642

643 **Key Questions for V2.1 Draft 1, LED Replacement Lamps**

- 644 1. The DLC has proposed that lamps must meet the same efficacy requirements as V2.0 luminaires  
 645 of 1.9 umol/J. Is the proposed efficacy reasonable? If not, please provide justification (i.e. data)  
 646 to support this rationale.
- 647 2. The DLC has not proposed requirements for lamps in a fixture housing (i.e. “in-luminaire”), but  
 648 instead uses distribution requirements for the bare lamp. Is this approach reasonable? If not,  
 649 please provide justification to support this rationale.
- 650 3. Should there be different distribution requirements for horizontally and vertically mounted  
 651 Screw-Base Replacements for HID Lamps?
- 652 4. Should the DLC include reporting requirements for mounting criteria, such as lamp orientation?  
 653 If so, which criteria specifically is critical to report?

654 **Tolerances**

655 The DLC accepts measurement tolerances to most metrics listed in the Technical Requirements. Please  
 656 refer to **Table 2** below for additional tolerance information.

657 **Table 2: DLC Horticultural Lighting Technical Requirements Tolerances**

Parameter/Attribute/Metric	V2.0 Tolerances
Photosynthetic Photon Efficacy	-5%
Power Factor	-3 percentage points
Total Harmonic Distortion	+5 percentage points
ISTMT Temperature Measurements	1.1°C or 0.4%, whichever is greater
LM-80 Drive Current	-5%

658

659 Tolerances are intended to account for all testing variation, rounding, and significant digits. The  
 660 requirement values and tolerances will be interpreted by DLC review staff as exact requirements. While  
 661 test labs will be expected to follow the requirements of their accreditation and relevant test standards,

662 DLC staff will not employ additional “rounding” to interpret values below the absolute thresholds as  
663 passing. For example, if a horticultural lighting product is required to have a PPE of 1.9 with an efficacy  
664 tolerance of -5%, any value for efficacy less than 1.81 will be interpreted as a failing value. It is the  
665 applicant’s responsibility to check all data presented in an application before submission to ensure  
666 compliance with the DLC requirements.

## 667 **Supporting Documentation**

### 668 **Test Reports**

669 The DLC requires that all testing be conducted at appropriately accredited laboratories except where  
670 noted otherwise. Specifically:

- 671 • Testing of flux, intensity, and electrical characteristics must be conducted at laboratories that  
672 are accredited to ISO 17025 and the appropriate reference test standard by accreditation bodies  
673 that are signatories to the ILAC-MRA.
  - 674 ○ Labs conducting whole-fixture performance testing must also follow the [DLC](#)  
675 [requirements for LM-79 labs](#).
- 676 • Labs conducting testing of device-level and/or fixture-level photon flux maintenance must also  
677 follow the [DLC requirements for LM-80/LM-84 labs](#).
- 678 • Labs conducting *In-Situ Temperature Measurement Testing* (ISTMT) must meet at least one of  
679 the following:
  - 680 ○ Approved by OSHA as Nationally Recognized Testing Laboratories (NRTLs)
  - 681 ○ Approved through an OSHA NRTL data acceptance program or OSHA Satellite  
682 Notification and Acceptance Program (SNAP)
  - 683 ○ Accredited for ANSI/UL 1598 or CSA C22.2 No. 250.0-08, including Sections 19.7, 19.10-  
684 16, by an accreditation organization that is an ILAC-MRA Signatory

### 685 **TM-33-18 Reporting and Photometric/Spectral Reporting Alternatives**

686 The DLC requires all applicants to submit accompanying .xml files per ANSI/IES TM-33-18 for each parent  
687 or single product to represent the spatial and spectral distribution of the tested fixture.

- 688 • The .xml file must be based on measured data from an accredited lab, accompanying the LM-79  
689 testing requirements for spectral and spatial measurements.
- 690 • The .xml file must include the spectral power distribution data, with an interval resolution of  
691 5nm or smaller over the photosynthetic and far-red range of wavelengths defined by  
692 ANSI/ASABE S640 (400-800nm). The DLC also requires the distribution of photon flux per photon  
693 wavelengths over the PBAR range (280-800nm) in the case that applicants provide  $PF_{PBAR}$  and  
694  $PE_{PBAR}$  data. Spectral data in 1nm intervals are acceptable. The spectral measurement  
695 represents the integrated flux in all directions from the fixture, without directional spectral  
696 information. Per TM-33-18, the data is reported in W/nm, not spectral quantum distributions.

697 All DLC developed and interim manufacturer submitted SQD images will report in  $\mu\text{mol} \times \text{s}^{-1} \times$   
698  $\text{nm}^{-1}$ .

- 699 • The .xml file must also include the Photosynthetic Photon Intensity Distribution (PPID), reported  
700 in  $\mu\text{mol} \times \text{s}^{-1} \times \text{sr}^{-1}$ , over the photosynthetic wavelengths defined by ANSI/ASABE S640 (400-  
701 700nm). PPID is the distribution of photosynthetic photon intensity per unit solid angle leaving  
702 the fixture. Each measurement is integrated across the 400-700nm range leaving the fixture and  
703 contains no granular spectral distribution information (i.e. color over angle).

704 To facilitate time for accredited labs to develop or purchase TM-33-18 reporting software, the DLC  
705 offers a 9-month grace period for applicants to provide .xml files compliant with TM-33 reporting for  
706 parent products. If TM-33-18 reports are not available, applicants must submit LM-63 and TM-27 (i.e.  
707 .ies and .spx files, respectively) for parent products or single products.

- 708 • For manufacturers choosing to submit .ies and .spx files instead of .xml files in the interim  
709 period, they must resubmit data compliant with TM-33-18 reporting requirements by December  
710 31, 2021, or the products will be delisted.
- 711 • The .ies files must contain [\_OTHER] keywords to describe the units of intensity values and a  
712 conversion factor relating photosynthetic photon intensity to luminous intensity (conversion  
713 factor = PPF/lumens).

## 714 Additional Application Details

715 In addition to the test data noted in the sections above, the DLC requires the following for all  
716 submissions:

- 717 • A completed web-based application form
- 718 • Specification sheets (or “cut sheets”) for the product that include maximum ambient  
719 temperature
- 720 • Specification sheets for all drivers and fans employed in the product, including lifetime-at-  
721 temperature information
- 722 • Safety certificates of compliance as issued by the relevant safety body, attested to by the DLC  
723 self-certification statement
- 724 • If demonstrating flux maintenance at the device-level, a completed TM-21 calculator must be  
725 provided for each LED device present in the fixture, with the applicable LM-80 and ISTMT  
726 information for that LED device. If demonstrating flux maintenance at the fixture-level, a  
727 completed TM-28 calculator must be provided for the fixture, with the applicable LM-84  
728 information accompanying it.

729 The DLC will only accept applications for products with testing on the product submitted, with only  
730 limited variations permitted as detailed in the sections above. Given the multiple options within product  
731 families, the DLC offers the [Family Grouping Application Requirements for LED-based Horticultural](#)  
732 [Lighting policy](#), which describes a method to determine “worst-case” product family members.