DRAFT Testing and Reporting Requirements for LED-based Horticultural Lighting

Version 1.2

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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 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 are eligible for DLC qualification. Products designed and intended to operate with DC voltages, powered by a remote AC-to-DC power supply, are also eligible for DLC qualification. Please see the Testing Methods and Requirements section for specific DC voltage matters. The following are further eligibility rules for horticultural lighting products:

- Products that are lamps (analogous to RP-16 sections 6.8.5.3 and 6.8.5.4), 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.

- Fixtures that incorporate light sources other than LED, whether as sole-source or as LED-hybrid fixtures, are not eligible.
- Fixtures that employ externally-supplied active cooling systems, including circulating-liquid and ducted forced-air, are not eligible. Those that incorporate internal active cooling systems that can be measured via standardized fixture test procedures, such as on-board fans, are eligible.

Testing Methods and Requirements

The DLC Technical Requirements for LED-based Horticultural Lighting are as follows. Details explaining each item follow below the table.

Table 1: DLC Horticultural Lighting Technical Requirements

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation
Photosynthetic Photon Flux (PPF) (µmol/s)	n/a	Reported	(LM-79-08) 400-700nm range, with 400-500nm, 500-600nm, and 600-700nm bins reported alongside the total
Far-Red Photon Flux (PF_{FR}) (µmol/s)	n/a	Reported	(LM-79-08) 700-800nm range
Spectral Quantum Distribution (SQD) (µmol/s·nm)	n/a	Reported	(LM-79-08) 400-800nm range
Photosynthetic Photon Intensity Distribution (PPID) (µmol/s·sr)	n/a	Reported	(LM-79-08*) 400-700nm range **Please see details below.*
Photosynthetic Photon Efficacy (PPE) (µmol/J)	≥1.9 µmol/J, with -5% tolerance	Required/Threshold	(LM-79-08) 400-700nm range
Photon Flux Maintenance, Photosynthetic (PFM_P)	Q_{90} ≥36,000 hours	Required/Threshold	(LM-80-15 / TM-21 or LM-84 / TM-28) 400-700nm range
Photon Flux Maintenance, Far-Red (PFM_{FR})	Report time to Q_{90}	Reported	(LM-80-15 / TM-21 or LM-84 / TM-28) 700-800nm range

Parameter/Attribute/Metric	Requirement	Requirement Type	Method of Measurement/Evaluation
Driver Lifetime	≥50,000 hours	Required/Threshold	Driver Technical Specification Sheet, Fixture Technical Specification Sheet, and *In-Situ Temperature Measurement Test* (ISTMT)
Fan Lifetime	≥50,000 hours	Required/Threshold	Fan Technical Specification Sheet, Fixture Technical Specification Sheet
Warranty	5 years	Required/Threshold	Legal Warranty Terms & Conditions
Power Factor	≥0.9	Required/Threshold	Electrical testing per LM-79-08
Total Harmonic Distortion, Current (THDi)	≤20%	Required/Threshold	Electrical testing per LM-79-08
Safety Certification	Appropriate Horticultural Lighting designation by OSHA NRTL or SCC-recognized body	Required/Threshold	Per safety certification body (see below)

Output Characteristics:

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

- **Photosynthetic Photon Flux (PPF), (µmol/s)**
  This is the total output of the product over the specific range of wavelengths defined by ANSI/ASABE S640 for PPF (400-700nm). This metric is an integrated value for the entire device, and contains no spectral or directional information.

  The DLC Horticultural QPL reports on both the total and 100nm-wide "bins" of flux within this range to allow end users to understand the fixture's relative proportions of "blue," "green," and "red" light. Test information must provide output in these ranges specifically, in addition to the total 400-700nm output.

- **Photon Flux, Far-Red (PF_{FR}), (µmol/s)**
  This is the output of the product over the "far-red" band defined by ANSI/ASABE S640 (700-800nm). This metric is an integrated value for the entire device, and contains no spectral or directional information. This metric is a reported field only.

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

- **Spectral Quantum Distribution (SQD), (µmol/s·nm)**
  This is the distribution of photon flux per photon wavelength over the photosynthetic and far-red range of wavelengths defined by ANSI/ASABE S640 (400-800nm). This distribution is measured and reported as integrated in all directions from the device, and contains no granular directional information itself. This distribution must be measured and reported from an appropriately-accredited facility.

  The DLC will continue to require an image of this distribution to be submitted with horticultural lighting applications through October, 2020. The DLC intends to require TM-33 for this data starting in the V2.0 cycle in October 2020. The image must be in a .jpg graphical file format, at a size of 300x300 pixels. This image is accessible to users on the QPL via download.

- **Photosynthetic Photon Intensity Distribution (PPID), (µmol/s·sr)**
  This is the distribution of PPF intensity per unit solid angle leaving the device. This distribution is measured and reported as integrated for all wavelengths across the 400-700nm range leaving the device, and contains no spectral distribution information itself.

  The DLC will continue to require an image of this distribution to be submitted with horticultural lighting applications through October, 2020. The DLC intends to require TM-33 for this data starting in the V2.0 cycle in October 2020. The image must be in a .jpg graphical file format, at a size of 300x300 pixels. This image is accessible to users on the QPL via download.

  **Note: The DLC will accept PPID images that are developed through in-house assessments. Although it is generally expected to align with LM-79 methodology, a formal LM-79 test will not be required.*

Efficacy:

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

All products are required to have a PPE of ≥ 1.9 µmol/J. In both initial applications and surveillance testing, the DLC allows an absolute tolerance of -5% to this threshold value. The result of this is the DLC's acceptance of any test report showing an efficacy of 1.81 µmol/J or higher, and the disqualification of any product, either at initial application or in post-approval surveillance testing, with a test report showing an efficacy less than 1.81 µmol/J, at any point in the product's specified operating voltage range. All evaluations of this measurement will be rounded to the second decimal place.

While, in general, family grouping approaches are not allowed (i.e. products must all have their own testing), limited variations for alternate drivers are allowed within the same product listing. If the product contains multiple drivers, is available with multiple drivers specifically for the capability of operating at multiple input voltages, or uses various drivers for supply channel flexibility:

- All driver spec sheets must be provided.
- For each unique driver used, manufacturers must provide electrical testing to demonstrate which driver variation results in the overall worst-case efficiency (and therefore efficacy) when at full designed operating power, as well as which variation results in the overall worst-case power quality (Total Harmonic Distortion, current or THDi, and Power Factor).
    - This testing shall include the input current and wattage, the output voltage, current, and wattage, and the THDi and PF, for each driver, at each nominal input voltage.
    - In-house (i.e. non-accredited lab) bench-top electrical testing is sufficient for demonstrating the driver efficiency at the applicable loading conditions and at the applicable input voltages.
    - From this electrical characterization testing, the product and conditions representing worst-case efficacy must undergo formal whole-fixture testing by an accredited lab.
- Drivers that result in explicitly different nominal performance (for example, if a driver change results in substantively different flux output or wattage consumption by the product, determined at the DLC's discretion) are not allowed variations within a single QPL listing. These changes require testing and submission of each version of the product, as well as distinct model numbers.

Long-Term Performance:

The DLC requires the following performance items to characterize the long-term performance and reliability of the device:

- **Flux Maintenance, PPF and PF_{FR}**
  This is a characterization of the ability of the device to maintain its output within the given ranges over time. Given that device output of interest is measured in quanta of photons, and not in lumens, the DLC is using the general engineering term for quanta, "Q", instead of the more-familiar "L" prefix used within general illumination applications.
    - The DLC requires either LED device-level or whole-fixture testing and projections in accordance with the (LM-80-15 and TM-21) or (LM-84 and TM-28) industry standards sufficient for a Q_{90} of ≥36,000 hours within the PPF range (400-700nm).
        - This evaluation result is based strictly on the value shown in cell I42 of the ENERGY STAR TM-21 calculator or cell I45 of the ENERGY STAR TM-28 calculator, when the rest of the spreadsheet is filled out correctly.
    - The flux maintenance point is set at a 10% reduction from initial product output due to the increased sensitivity of plant metabolism to reduced flux. While human vision can

tolerate a 30% loss of output across a fixture's life (the intent of the L_{70} extrapolation), the reduced plant growth resulting from reduced flux is a significant factor in end users' economic calculations.

- All TM-21 or TM-28 projections must be made at the maximum environmental temperature on the fixture's specification sheet. See ISTMT information below for additional details.
- The DLC requires testing and projections to report Q_{90} for the PF_{FR} range of 700-800nm, but does not make determinations or qualifications based on this data. Please see a description of PFM_{FR}-specific testing requirements in the section below, titled "For fixtures using multiple types of LEDs".
- To support PFM_P and PFM_{FR} projections, LM-80-15/LM-84 information must be provided for both the 400-700nm and the 700-800nm range.
    - Beginning on October 15, 2019, all new product submissions using the LM-80/TM-21 approach will be required to provide LM-80 data in appropriate (PPF, PF_{FR}) units, measured as such at all time points in the LM-80 procedure. Reports referring to "photon flux" that are ambiguous (based on product SPD) about the division of said flux between the PPF and PF_{FR} categories will not be accepted.
        - Products qualified with non-PPF units that were not converted into a PPF basis during the October 2018 – October 14th, 2019 provisional period will have until April 2020 to update their listings with actual PPF maintenance data, or will be delisted. DLC staff will contact each product's manufacturer several times during the October 2019-April 2020 period to coordinate this update process. No extra fees will be required.
        - Products qualified with non-PPF units that were converted into a PPF basis during the October 2018 – October 14th, 2019 provisional period will remain on the QPL through April 2021.
        - Products initially qualified using this provisional approach will be allowed to update their listings to remove any caveats by submitting actual data whenever it becomes available. The DLC will carry out these updates with a custom process through the October 2019 – April 2020 period, as described above, and will issue detailed guidance for this process by October 2019.
    - Products may not be qualified and listed on the QPL without long-term performance data for flux degradation. Products which use LEDs for which no LM-80 data are available are required to undergo LM-84 testing for TM-28 projections.
- *In-Situ Temperature Measurement Testing* (ISTMT) 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 purposes. Specifically, applicants must characterize the operating temperature of the LED at the fixture's highest rated ambient temperature. This must be done in accordance with acceptable procedures from safety testing for measuring and projecting operating temperatures generally. 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, as defined by the thermal portions of the relevant safety standards, must be taken to characterize the LED operating temperature when the fixture is in a 40°C ambient environment.

- 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.
    - By "type" of LED, the DLC means both the nominal output of the LED device, as well as 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 cross-applicability of LM-80 data is allowed within phosphor converted white LEDs of the same series; see LM-80 applicability information below.
  - ISTMT testing must be provided on the hottest of each of the LED types (For example, the hottest blue, white, and red LED in the fixture, respectively).
  - Maximum drive current must be reported for each of the LED types.
  - For PFM_P (400-700nm), each LED type present in the fixture that has at least 25% of its per-device flux in the PPF range must independently meet the $Q_{90} \geq$ 36,000 hours requirement, as shown by a TM-21 calculation. The DLC does not require device-level SQD data from submitters, and will largely accept (while reserving the right to request explanation) submitters' descriptions of a device's relative PPF flux. The DLC reports the minimum PFM_P value out of all submitted values on the QPL.
  - The DLC will require calculated PFM_{FR} for all fixtures with a PF_{FR} output that is equal to or greater than 5% of the fixture's flux from 400-800nm. For PFM_{FR} (700-800nm), each LED type present in the fixture that has at least 25% of its per-device flux in the PF_{FR} range must report its Q_{90} duration in hours. The DLC does not require device-level SQD data from submitters, and will largely accept (while reserving the right to request explanation) submitters' descriptions of a device's relative PF_{FR} flux. The DLC reports the minimum PF_{FR} Q_{90} projection out of all submitted for each LED type present in the fixture on the QPL. There is no

threshold performance requirement across this far-red range: it is a reported value only.

- LM-80 applicability: for phosphor-converted "white" LEDs within the ANSI nominal chromaticity range, the DLC follows the *ENERGY STAR Requirements for the Use of LM-80 Data* published October 2016, as the DLC does in its SSL General Illumination Program. For narrow-band emitters (i.e. LEDs targeted at a particular wavelength like "red", "blue", "green", etc.), the DLC requires an LM-80 for each distinct nominal product offered by an LED device manufacturer.

- **Warranty**

  Products must have a manufacturer-provided warranty of at least 5 years. The warranty terms and conditions must be provided as part of the submittal for qualification. Terms and conditions must not exclude key components such as the LED, driver, cooling fans (if present), or optics.

- **Driver ISTMT**

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

  As noted in the ISTMT description within the flux maintenance section, driver ISTMTs must be conducted and reported in the same manner as thermal testing for safety purposes. Specifically, applicants must characterize the operating temperature of the driver at the fixture's highest rated ambient temperature. This must be done in accordance with acceptable procedures from safety testing for measuring and projecting operating temperatures generally. For example, if a luminaire is rated for operation at 40°C ambient, ISTMTs are not accepted if they only show the temperature of the driver when measured during a 25°C ambient condition. In this example, appropriate steps, as defined by the thermal portions of the relevant safety standards, must be taken to characterize the driver operating temperature when the luminaire is in a 40°C ambient environment.

  - For products that may use multiple drivers, spec sheets for each driver must be provided with the details above. Testing must be conducted on each driver at its appropriate worst-case input voltage. If a product uses multiple drivers from both the same manufacturer and product line or series, then the single worst case thermal environment of the set requires a driver ISTMT. The DLC will operate with the expectation that the least electrically-efficient driver in the manufacturer's product line or series is the worst-case thermal environment, but the reviewer may ask the manufacturer to provide detailed evidence to demonstrate the worst case driver thermals. If products use multiple drivers, product lines, or series, then independent testing of each logical grouping for ISTMT performance will be required.

- Driver ISTMT details are not required for DC-powered fixtures.

- **Fans**
  Products that employ on-board cooling fans must provide a technical specification sheet for each fan type employed in the product. The fan specification sheet must specifically state the lifetime of the fan and a reference operating temperature rating for that lifetime claim. The lifetime must be at least 50,000 hours, at an environmental temperature at or above the fixture's highest rated ambient temperature.

  If the product is available with multiple fan models specifically for supply channel flexibility:

  - If a fan model changes results in substantively different component temperature or wattage consumption by the fixture (determined at the DLC's discretion), testing and submission of each version of the fixture, as well as distinct model numbers, will be necessary. DLC reviewers will examine fan model power levels and flow rate to determine this distinction.

Electrical Performance/Power Quality:

The DLC requires the testing and reporting of the following to characterize the electrical performance of the device:

- **Power Factor**
  Products must have a measured power factor of ≥0.90 at any rated input voltage and maximum designed output power.

  - Power factor testing is not required for DC-powered fixtures.

- **Total Harmonic Distortion, current (THDi)**
  Products must have a measured THDi of ≤20% at any rated input voltage and maximum designed output power.

  - THDi testing is not required for DC-powered fixtures.

For products with driver variations, including input voltage variations, electrical testing of each product must be performed, sufficient to characterize the power quality of each driver, at its applicable nominal input voltages and maximum designed output power. Worst-case variations identified must be tested in an accredited laboratory. Characterization testing may be done on an in-house or benchtop set up for practical simplicity, and results must be documented and included in the application materials.

Safety:

The DLC requires products to be appropriately safety certified by a relevant safety certification body in the United States or Canada. Specifically, products must be certified by an OSHA NRTL or SCC-recognized body to a set of safety requirements and standards deemed applicable to *horticultural lighting products* by that safety organization.

As an ANSI-accredited safety standard for horticultural lighting products does not currently exist, the DLC will remain in contact with relevant safety organizations to understand how they are certifying

these products and to ensure that certifications are in accordance with those bodies' relevant practices. If an ANSI-accredited safety standard for horticultural lighting does become available after these requirements are published, the DLC intends to require certifications specifically to that standard for new applicants only after consulting with safety certification bodies to ensure the industry is ready to meet end user volume needs.

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

- **UL**
  UL has defined a preliminary Outline of Investigation (OOI), currently identified as UL 8800, for the review and certification of horticultural lighting products. Device manufacturers who use UL for safety certification purposes are required to be listed on the UL Certification Directory under the designation IFAU.

- **ETL/Intertek**
  ETL has defined an internal set of guidelines for certifying horticultural fixtures. Although there is not a reference number for ETL's guidelines, they generally harmonize with UL 8800, with minor additions. Device manufacturers who use ETL for safety certification are required to be listed on the ETL Certification Directory, specifically as Horticultural Fixtures.

- **CSA Group**
  CSA Group has generated a List of Technical Requirements (LTR) for horticultural lighting equipment products in Canada, which are publicly accessible. The LTR provides certification guidance used to evaluate products for safety compliance to Canadian Electrical Code, Part 1, by directly referencing applicable published Canadian standards. The combination of the CSA LTR and UL OOI UL 8800 facilitates a harmonized product safety certification. Device manufacturers who use CSA for safety certifications are required to be listed under CSA Group's Classes defined for horticultural lighting equipment in Canada and the US.

- **TÜV SÜD**
  TÜV SÜD has defined an internal set of guidelines for certifying horticultural fixtures. Although there is not a reference number for TÜV SÜD's guidelines, they generally harmonize with UL 8800. Device manufacturers who use TÜV SÜD for safety certification are required to be listed on the TÜV SÜD Certification Directory, specifically as horticultural lighting equipment.

- **SGS**
  SGS has defined an internal set of guidelines for certifying horticultural fixtures. Although there is no reference number for SGS guidelines, they generally harmonize with UL 8800. Device manufacturers who use SGS for safety certification are required to be listed on the SGS Certification Directory, specifically as horticultural lighting equipment.

- **Other safety organizations**
  The DLC will work with other safety organizations to understand their rules for horticultural products as necessary. To be added, safety organizations should contact horticulture@designlights.org.

Special Considerations for Spectrally Tunable Devices

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

- The threshold-qualifying state to be tested must be the manufacturer-designed state with the highest power consumption ("maximum power"). This may or may not be the same as an "all channels on" condition, since fixtures may not be designed to use all their channels simultaneously. Test reports must specifically state that the product is operated in this "maximum power" mode during the testing, with a description of the control narrative to ensure that the power state is at its maximum designed level.
- In addition to the "maximum power" condition, products must perform PPF testing for each control channel, in which the channel under test must be set to the maximum designed output, while all other channels must be set to their minimum designed output for this state. The test report must present an identifying name of this channel and setting, the PPF (400-700nm total with three, 100nm-wide "bins"), PF_{FR} (700-800nm), for each of the single-channel scenarios, and a description of the control narrative to achieve each setting. For each channel tested, a corresponding graphic for the SQD produced in that setting must be provided in the application.

  **Note: The DLC will accept control channel composition data collected via in-house assessment tests. Although it is generally expected to align with LM-79 methodology, a formal LM-79 test will not be required.*

  - The output of each specific channel testing is displayed on the DLC Horticultural QPL, with the per-channel test outcomes shown alongside those of the "maximum power" state, along with identifying information for each setting. These data are intended to support standardized communication of information about the product's spectral tuning range, aiding product selection and user acceptance.
- Products must provide user-facing documentation narrating the control protocol and input parameters employed in controlling the output.
- For PFM_P and PFM_{FR} evaluation:
  - Provisions for products utilizing multiple types of LEDs (above) must be followed.
  - ISTMT testing must be provided on the hottest of each of the LED types. For each unique LED type, ISTMT testing must occur at the operating mode that produces the highest operating temperature in the fixture, for this LED type.
  - The DLC asks any submitters considering LM-84-based maintenance testing on a spectrally tunable fixture to contact horticulture@designlights.org to discuss their proposed testing pattern to ensure a successful outcome.

Special Considerations for DC-Powered Fixtures

- For DC-powered fixtures, the DLC requires testing of the fixture at the manufacturer's recommended power and voltage state to obtain these output characteristics. The DLC intends

to determine, evaluate, and list efficacy and power at the "wall plug" AC equivalent state for DC-powered fixtures.

- DC-powered fixtures present challenges to determining efficacy from an end user and utility perspective. The DLC will accept tested data of a DC-powered fixture in its DC state, then modify PPE and power test data based on a single power supply efficiency value, known as the "80PLUS Derating Factor", derived from the nationally-known 80PLUS DC power supply testing and certification program. **This value will be based on the 80PLUS Platinum performance level, and will be 92%.** This will have the effect of reducing the tested values for PPE, increasing the tested values for power, and maintaining the tested photon flux values.
    - The formulas the DLC reviewer will use to evaluate the "derated" power and efficacy values are:
        - $Power_{AC} = \frac{Power_{DC}}{80PLUS\ Derating\ Factor}$
        - $PPE_{AC} = PPE_{DC} * (80PLUS\ Derating\ Factor)$
    - All values displayed on the QPL will be the "derated" values in the AC power context, to give utilities and end users a meaningful method of comparing products across the AC and DC-powered contexts. Manufacturers are not barred from using DC-context data in their marketing material, but DLC reviewers will reserve the right to request any changes to information that may be considered misleading or confusing. All derated values will be evaluated to the second decimal place, and the single 1.9 µmol/J efficacy threshold will be the evaluation minimum.
- The DLC recommends that utility program managers referring to the Horticultural QPL require installation and use of power supplies certified at or above the 80PLUS level referred to in these requirements (i.e., Platinum or Titanium).
- To ensure that wiring losses are no more than those in AC systems, the DLC recommends that utility program managers referring to the Horticultural QPL require an electrical code inspection of projects using DC-powered horticultural fixtures.

Tolerances

Except on PPE, where tolerance is specifically noted to be -5%, measurement tolerances in for horticultural lighting products directly mimic the requirements in the DLC program for SSL for General Illumination. Specifically:

- There is a tolerance on all ISTMT measurements of 1.1°C or 0.4%, whichever is greater, for all thermal measurements.
- There is a tolerance of 5% for drive currents tested in LM-80.
- There is a tolerance of 3 percentage points on power factor measurements.
- There is a tolerance of 5 percentage points on THDi measurements.

Supporting Documentation

Test Reports

The DLC requires that all testing be conducted at appropriately accredited laboratories. Specifically:

- Testing of flux, intensity, and electrical characteristics must be conducted at laboratories that are accredited to ISO 17025 and the appropriate reference test standard by accreditation bodies that are signatories to the ILAC-MRA.
    - Labs conducting whole-fixture performance testing must also be acceptable via the DLC requirements for LM-79 labs in the DLC SSL QPL program.
- Labs conducting testing of device-level and/or fixture-level photon flux maintenance must also be acceptable via the DLC requirements for LM-80/LM-84 labs.
- Labs conducting *In-Situ Temperature Measurement Testing* (ISTMT) must meet at least one of the following, consistent with requirements for SSL for general illumination:
    - Approved by OSHA as Nationally Recognized Testing Laboratories (NRTLs)
    - Approved through an OSHA NRTL data acceptance program or OSHA Satellite Notification and Acceptance Program (SNAP)
    - Accredited for ANSI/UL 1598 or CSA C22.2 No. 250.0-08, including Sections 19.7, 19.10-16, by an accreditation organization that is an ILAC-MRA Signatory

Additional Application Details

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

- A completed web-based application form
- Specification sheets (or “cut sheets”) for the product
- Marketing brochures used to describe and sell the product
- Specification sheets for all drivers and fans employed in the product, including lifetime-at-temperature information
- A self-certification statement, in the form of a digital signature made during the application process
- Safety certificates of compliance as issued by the relevant safety body, attested to by the self-certification statement above
- If demonstrating flux maintenance at the device-level, a completed TM-21 calculator must be provided for each LED device present in the fixture, with the applicable LM-80 and ISTMT information for that LED device. If demonstrating flux maintenance at the fixture-level, a completed TM-28 calculator must be provided for the fixture, with the applicable LM-84 information accompanying it.

The DLC will only accept applications for products with their own testing, with only limited variations for drivers allowed, as specified in the "Efficacy" section above. Additional grouping or "family" approaches will be considered if market conditions warrant as the sector matures. Given the multiple different axes of performance and product variability in this application, the DLC will be observing product data to determine equitable ways to determine "worst case" product family members, which would be a prerequisite for family grouping approaches.

Requirements Update Intervals and Product Qualification Duration

Update Interval

The DLC Horticultural Lighting Program intends to follow a 24-month major update cycle and a 12-month minor update cycle. Six months prior to the new major cycle's start date, the DLC will announce a new efficacy threshold for the upcoming requirements revision. The new threshold will be based on a query of all qualified products in its Horticultural QPL and determine the fifteenth percentile of PPE – that value which is the dividing line between the least efficacious 15% of products, and the more efficacious upper 85% of products. Further details of how the DLC will operate its major and minor update cycles can be found here.

Product Qualification Duration

The DLC allows products qualified during a major revision cycle to remain on the QPL for the duration of the current cycle, plus a grace period of six months. Those products meeting the requirements of the following cycle will have a means of easily confirming their continued commercial availability, and those requiring an update to their tested performance will have a means of easily updating their existing product. Those products that are not re-confirmed or updated for the following revision cycle's requirements will be delisted at the end of the six-month grace period following the onset of the new requirements becoming active. Further details of how the DLC will manage product qualifications of varying net duration can be found here.

Example Time Table

To review the structure of this proposed revision update and qualification duration, please see the companion document, "Horticultural Lighting Requirements Revision Schedule".