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SECOND DRAFT Testing and Reporting Requirements for Direct-Current (DC) and Power over Ethernet (PoE) Lamps, Luminaires, and Retrofit Kits

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Products powered by Direct Current (DC) and Power over Ethernet (PoE) must comply with the provisions of this document to be eligible for listing on the DLC Solid-State Lighting Qualified Products List (SSL QPL). DC/PoE products are defined as SSL lamps, luminaires, and retrofit kits that are powered by a DC voltage. They will be listed as DC or PoE products on the DLC’s SSL QPL. If DC/PoE lamps, luminaires, and retrofit kits are also capable of being powered by AC voltage and the manufacturer desires to have them listed as suitable for both AC and DC, then the AC listing of the product must have a distinct model number that is different from the DC listed product, and it must be separately qualified.

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The DLC intends to list DC/PoE lamps, luminaires, and retrofit kits on its SSL QPL based only on the luminous efficacy of these products as measured at their DC power input. The overall energy consumption of the DC/PoE systems also depends on DC line losses and DC power source efficiency, in addition to luminaire or lamp efficacy. However, given the variation in system architectures and power losses, the DLC will not be publishing system-level efficacies. The DLC is developing a separate document to be provided to utility and energy efficiency program administrators that will provide basic guidance for accounting for system losses of DC/PoE SSL products. In combination with the DC/PoE QPL listings, this guidance document will allow efficiency program administrators to calculate system efficacy on a custom basis and provide financial incentives/rebates for DC/PoE technologies.

Definitions

The following are definitions associated with DC/PoE products:

1. **DC Power Source:** In this policy, the term “DC Power Source” is used to indicate the device(s) that connect AC mains to the lines directly providing DC input power to the DC/PoE product. Though DC/PoE products may be used entirely disconnected from the AC power grid, the primary focus of this policy is grid-connected SSL lighting. A DC Power Source may be more typically known as any of the following:

- a. **AC-to-DC Power Converter**

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- 29 b. **Power over Ethernet Power Sourcing Equipment** (PoE PSE), also known as a PoE
30 Switch
- 31 c. **AC/DC Multi-Directional Inverter**
- 32 2. **DC-to-DC Driver:** An LED driver that is typically integrated into the luminaire that converts the
33 DC voltage received at the DC luminaire into the DC voltage required to operate the LEDs in the
34 lamp, luminaire, or retrofit kit. Not all DC/PoE lamps, luminaires or retrofit kits require a DC-to-
35 DC driver.

36 Eligibility

37 The following are eligibility rules for DC/PoE products:

- 38 • DC/PoE products are not eligible to be submitted as “Single Product” DLC application types.
39 Both single DC/PoE products and DC/PoE product families must submit a “Family Grouping” DLC
40 application and be tested in accordance with the requirements of [the family grouping policy](#).
- 41 • DC/PoE products must meet all DLC Technical Requirements for minimum lumen output,
42 efficacy, Correlated Color Temperature (CCT), Color Rendering Index (CRI), lumen maintenance,
43 and zonal distribution/spacing, with the exception of THD and Power Factor, for the General
44 Application(s) and Primary Use(s) for which they are submitted.
- 45 • Products marketed or intended for use disconnected from the AC power grid are eligible for
46 listing on the SSL QPL. However, eligibility of these products for efficiency program rebates is at
47 the discretion of program administrators and should not be assumed based only on QPL listing.
- 48 • Linear Replacement Lamps, Screw-base Replacement Lamps, and Four Pin-base Replacement
49 Lamps for CFLs are only eligible for listing if they are UL Type C.
- 50 • DC/PoE luminaires will only be classified as DLC Premium if they meet all DLC Premium
51 classification requirements. An LED Driver ISTMT is required for DLC Premium submissions of
52 luminaires with an integrated DC-to-DC driver. Additional documentation is required for the
53 driver per the [requirements for Premium luminaires](#).
- 54 • DC/PoE products may also have [Color-Tunable](#) or [Dimmable](#) product features, in which case
55 they are also subject to the relevant DLC Testing and Reporting Requirements for those types of
56 products. If products exhibit multiple performance features, they must comply with all
57 applicable Testing and Reporting Requirements.

58 Testing Methods and Requirements

59 Testing for DC/PoE products or family groups must be provided to cover all areas of investigation as with
60 AC products or family groups. The below requirements apply to the DC/PoE luminaire, lamp, or retrofit
61 kit under consideration, as test reports will not be required on the DC Power Source.

62 1. DC/PoE products or family groupings shall be tested according to the guidelines for electrical
63 instrumentation of DC devices in the latest version of the Illuminating Engineering Society's (IES)
64 LM-79 publication.

- 65 a. The intent of the LM-79 Test Reports required for DLC submission is measurement
66 of the luminaire efficacy as well as other photometric characteristics under DC
67 power without including DC Power Source conversion losses or line losses.
- 68 b. Many DC/PoE products, for example PoE, utilize multiple conductors. LM-79 Test
69 Reports shall be based on the sum of all power delivered to the product across all
70 connected conductors. The test report shall document the number of powered
71 conductors, and pair-wise grouping if applicable.
- 72 c. Voltage and current measurements shall be made at the point of entry to the
73 product or luminaire, before any DC-to-DC driver circuitry. If the test laboratory is in
74 doubt about the proper interconnection or placement of voltage sensing leads for
75 power measurement, they should consult the manufacturer.
- 76 d. Test laboratories shall not connect measurement equipment in such a manner that
77 disrupts data communication if the DC power connection carries both data and
78 power. Manufacturers should, if necessary, provide testing labs with instructions for
79 achieving a state of full light output without the consumption of unnecessary
80 communication power. The identical instructions as were provided to the test
81 laboratory must be provided to the DLC as part of the application review and will be
82 provided to the surveillance testing laboratory if the product is selected for
83 surveillance testing.
- 84 e. Any removable accessories not required to achieve full light output, such as
85 removable photosensors or occupancy sensors, shall be removed during LM-79
86 testing. Any accessories with controllable power states that are not required to
87 achieve full light output, such as cameras, microphones or external luminaire power
88 connections, shall be disabled/powered down during LM-79 testing.

89 2. The luminous efficacy according to the LM-79 Test Method shall be provided at two voltages:

- 90 a. The DC input voltage that results in the worst-case luminous efficacy. The tested
91 voltage must result in the worst luminous efficacy across the product's operating
92 range of input voltage listed in the manufacturer's specification sheets and, if
93 applicable, within the input voltage range of the established system protocol (e.g.
94 between 42.5V and 57V for IEEE 802.3at Type 2 PoE powered devices). For any
95 application where the worst-case submitted voltage is not the lowest voltage in the
96 operating range, the manufacturer must submit a written justification explaining
97 why their product performs at lower luminous efficacy at the higher input voltage.
- 98 b. A nominal DC voltage chosen by the manufacturer. The nominal DC voltage chosen
99 must be within the product's operating range of input voltage according to the
100 manufacturer's specification sheets, and, if applicable, within the input voltage
101 range of the established system protocol (e.g. between 42.5V and 57V for IEEE

102 802.3at Type 2 PoE powered devices) and less than any maximum voltage permitted
103 under the National Electrical Code for the wiring and power specified (e.g. NEC
104 maximum of 60V for Class 2 above 5 mA). The nominal voltage shall be different
105 from the worst-case voltage from section (a) above.

106 3. Manufacturers must provide instructions to the testing laboratory for how to achieve the full
107 light output state for LM-79 testing. Full light output state is defined as the light output state
108 where the product is delivering its maximum lumen output, with any dimming input control
109 signal set to the maximum setting. The identical instructions as were provided to the test
110 laboratory must be provided to the DLC as part of the application review, and will be provided
111 to the surveillance testing laboratory if the product is selected for surveillance testing.

112 4. In-Situ Temperature Measurement Tests (ISTMTs) must be conducted in the most appropriate
113 application as defined by its appropriate safety standard, per applicable safety certifications.
114 TM-21 projections will use this thermal measurement in conjunction with the provided LM-80
115 data and rated drive current to evaluate lumen maintenance and compliance with L₇₀
116 requirements. Alternatively, LM-84 testing and TM-28 projections will be acceptable. Please
117 contact info@designlights.org if you intend to use this alternative LM-84 approach.

118 Supporting Documentation

119 Applicants shall provide the following supporting documentation with the application submittal. If any of
120 the following information is not clearly documented in the installation guide, product specification
121 sheet, or other supporting technical or marketing materials, the application will be considered
122 incomplete and the DLC reviewer will put the application on hold while they request additional
123 information.

- 124 • Product Installation, Power Source, and Wiring documentation covering the following:
 - 125 ○ Nominal input voltage to luminaire, lamp or retrofit kit, when applicable
 - 126 ○ Range of acceptable input voltages to luminaire, lamp, or retrofit kit
 - 127 ○ List of compatible DC Power Source models and/or parameters for choosing compatible
128 DC Power Sources
 - 129 ○ List of compatible cable models, and/or parameters for choosing wiring gauge and type
 - 130 ○ Where applicable, reference to standard compliance and relevant product
131 subcategories/classifications
 - 132 ○ For PoE products, reference to IEEE 802.3af/at/bt standard compliance, PoE type, and
133 device class
- 134 • Applicable standard certificate, where applicable, for example IEEE 802.3 PoE standard
135 compliance certificate by the Ethernet Alliance if IEEE 802.3 compliance is claimed
- 136 • Safety Certification

- 137 ○ The requirements for safety certification of DC/PoE products are functionally the same
138 as the safety certification requirements for AC products on the SSL QPL.

139 **Listing on the QPL**

140 The DLC intends to list DC/PoE lamps, luminaires, and retrofit kits on its SSL QPL based only on the
141 luminous efficacy of these products as measured at their DC power input. DC/PoE products will be listed
142 on the SSL QPL according to their worst-case efficacy as documented in the LM-79 report(s) specified in
143 Section 2a of the Testing requirements above. All existing QPL fields will apply to DC/PoE products
144 except for Total Harmonic Distortion (THD) and Power Factor (PF). These two fields will be either left
145 blank or “N/A”. DC/PoE products will be distinguished from Alternating Current (AC) products on the SSL
146 QPL as follows:

- 147 ● DC/PoE listings on the QPL will prominently feature and point to a supplemental guide or pop-
148 up window that provides important information for how to use the DC/PoE listing data, which is
149 different from non-DC/PoE listing data.
- 150 ● Five new fields will be required for DC/PoE listings and one existing field may be modified:
 - 151 ○ **“System Type”**. This new field would apply to all products on the QPL and would be
152 populated with text as “AC”, “DC”, or “PoE”.
 - 153 ○ **“Test Voltage”**. This new field would be needed for DC and PoE products and may also
154 be applied to existing AC products. It would be a numerical value that lists the voltage
155 from the LM-79 test report (e.g. 24 Volts, 380 Volts, etc.) that corresponds to the worst-
156 case luminous efficacy listed for that product.
 - 157 ○ **“Voltage Range”**. This new field would be applied to both AC and DC products, and
158 would list the range of acceptable input voltage for the product (e.g. 120-277VAC, 44-
159 57VDC).
 - 160 ○ **“DC Efficacy”**. This new field would list the worst-case efficacy of DC/PoE products,
161 which is different from the current “efficacy” field of existing products. The existing
162 “efficacy” field on DLC’s QPL would be changed to “AC efficacy” to clearly differentiate
163 from the “DC efficacy” of DC/PoE products.
 - 164 ○ **“PoE Type/Class”**. This new field would list the Type and Class of PoE utilized.
 - 165 ○ **“PoE Connection”**. This new field would indicate whether the product connects directly
166 or indirectly to the PoE network, for example, whether a luminaire connects directly to
167 the PoE network, or indirectly through another luminaire or driver that is connected to
168 the PoE network.