BACKGROUND

The Hong Kong Green Label Scheme (HKGLS) is an independent and voluntary scheme, which aims to identify products that are, based on life cycle analysis consideration, more environmentally preferable than other similar products with the same function. The Scheme is organized by the Green Council (GC) with contributions from the HKGLS Advisory Committee and a number of supporting organizations.

The prime objectives of HKGLS are:

- For Consumers: assist in making purchases of products that are less harmful to the environment;
- For Industry: stimulate development and production of environmentally preferable alternatives.

This specification sets out the requirements that the light-emitting diode (LED) will be required to meet in order to be licensed to use the HKGLS label. The requirements include environmental criteria and product characteristics. The specification also defines the testing and other means to be used to verify conformance with the environmental criteria and product characteristics.

POTENTIAL ENVIRONMENTAL IMPACTS

In recent years, the dramatic improvements in performance and significant cost reduction, LEDs can be found in a variety of lighting applications. Increasingly, they are being used as low-energy indicators, but also for replacement of traditional light sources in general lighting and automotive lighting applications. Although there are many advantages over traditional light sources (e.g. incandescent and fluorescent light products), including lower energy consumption, longer lifetime, improved robustness, smaller size and faster switching, LEDs are relatively more expensive and require more precise current and heat management than traditional light sources.

LABEL OBJECTIVE

The aim of the environmental criteria developed for the LED lamps is to:

- Reduce the use of the environmentally harmful substances;
- Promote improved technical life-span of lamps;
- Reduce energy consumption and promote energy-saving lamps; and
- Minimize waste production by reducing the amount of primary packaging and promoting its reusability and/or recyclability.

PRODUCT DEFINITION

This document and all product environmental criteria therein apply to integral LED lamps, which is used by directly connecting to a commercial power source. These criteria include integral LED lamps intended to replace incandescent lamp, decorative (candelabra style) lamps, fluorescent lamp, halogen lamp or lamp for street lighting.

Colour Rendering Index refers to the comparison of the spectral tri-stimulus values of the objects under test illumination and standard illumination according to the recommendations of CIE publication No. 13.3-1995.

Correlated Colour Temperature (CCT) means the temperature of the Planckian radiator whose perceived colour most closely resembles that of a given stimulus at the same brightness and under specified viewing conditions.

Directional Lamp refers to the minimum of 80% of light output within a solid angle of π sr (corresponding to a cone with angle of 120 degree).

LED refers to light emitting diode, which is a pn junction semiconductor device that emits incoherent optical radiation when biased in the forward direction. The output is a function of its physical construction, material used, and exciting current and may be in the ultraviolet, the visible or in the infrared regions of the spectrum.

LED control circuitry refers to electronic components located between the power source and the LED array designed to limit voltage and current, to dim, to switch, or otherwise control the electrical energy to the LED array. The circuitry does not include a power source.

LED driver refers to power source with integral LED control circuitry designed to meet the specific requirements of a LED lamp or a LED array.

IEC refers to International Electrotechnical Commission.

Integral LED lamp refers to lamp with LEDs, an integrated LED driver and an ANSI standardized base that is designed to connect to the branch circuit via an ANSI standardized lampholder / socket.

Luminous efficacy refers to the ratio of total luminous flux (in lumens, Lm) to power input (in watts, W) in units of Lm/W.

Lumen maintenance refers the luminous flux at a given time in the life of the LED and expressed as a percentage of the initial luminous flux.

Power Factor refers to the ratio of measured active input power to product of supply voltage and supply current (measured in root mean square).

PRODUCT ENVIRONMENTAL CRITERIA

The table below sets out the product environmental criteria for the LED lamps (GL-007-010) under the HKGLS.

Product Environmental Criteria	Verification Method(s)*
1. Chemical Substances	
1.1 Mercury, lead, cadmium, chromium VI, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) shall not be used as constituent parts of product, in accordance with the Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment 2002/95/EC (commonly referred to as the Restriction of Hazardous Substances Directive or RoHS).	✓ Review of laboratory test report(s); AND ✓ Review of supporting information. The applicant shall provide test report(s) in according to HKGLS requirement or provide declare compliance with the requirement together with appropriate documentation (e.g. RoHS compliance certificate)
1.2 Short-chain chlorinated paraffins (C=10 to 13) with 50% chlorine or above shall not be used in products.	✓ Review of laboratory test report(s); AND ✓ Review of supporting information. The applicant shall provide test report in according to HKGLS requirement or provide declare compliance with the requirement together with appropriate documentation (e.g. MSDSs)
1.3 Synthetic resin components used in the housing of the LED weighing over 25g shall not contain halogen compound. Exemption for organic fluorine additive (e.g. anti-dripping agent) with weighing ≤0.5%.	✓ Review of supporting information; AND ✓ Interview with relevant personnel. The applicant shall declare compliance with the requirement together with appropriate documentation (e.g. MSDSs)

Product Environmental Criteria	Verification Method(s)*
2. Recyclability (Optional) Plastic parts weighing over 25g and with an even surface of over 200mm, excluding extruded plastic materials, shall be marked for identification according to the ISO11469 Standard.	✓ Review of supporting information; AND ✓ Interview with relevant personnel. The applicant shall declare compliance with the requirement
3. Durability 3.1 Lumen Maintenance (L_{70}): Lamps shall deliver at least 70% of initial lumens for at least 6,000 hours.	✓ Review of laboratory test report(s) [Refer to Note]; AND ✓ Review of supporting information.
3.2 Chromaticity change: Chromaticity change shall be within 0.007 on the CIE 1976 (u', v') diagram after 6,000 hours.	✓ Review of laboratory test report(s) AND ✓ Review of supporting information.
3.3 The switching withstanding of a product shall be ≥ 10,000 times.	✓ Review of laboratory test report(s) AND ✓ Review of supporting information.
3.4 The replacement and reassembly of individual LEDs and main components shall be easily executed with regular tools (e.g. screwdriver).	✓ Review of supporting information; AND ✓ Interview with relevant personnel. The applicant shall declare compliance with the requirement.
3.5 A warranty shall be provided for lamps, covering repair or replacement for a minimum of 1 year from the date of purchase. (optional)	✓ Review of supporting information; AND ✓ Interview with relevant personnel. The applicant shall declare compliance with the requirement.

Product Environmental Criteria	Verification Method(s)*
4. Performance and Energy Consumption	
4.1 Color Rendering Index (CRI) of at least 80.	✓ Review of laboratory test report(s) [Refer to Note]; AND ✓ Review of supporting information.
4.2 Color Correlated Temperature (CCT): Lamps shall have one of the CCTs including 2700K, 3000K, 3500K, 4000K, 4500K, 5000K, 5700K, 6500K and flexible CCT consistent with the 7-step chromaticity quadrangles and Duv tolerances as indicated in Table 2.	✓ Review of laboratory test report(s) AND ✓ Review of supporting information.
4.3 The luminous efficacy of new LED shall meet the following requirement as described in Table 1: 4.3.1 Non-directional lamp: • Luminous efficacy (lm/W) for LED lamp power < 10W shall meet 50lm/W. • Luminous efficacy (lm/W) for LED lamp power ≥ 10W shall meet 55lm/W. 4.3.2 Directional lamp: • Luminous efficacy (lm/W) for lamp diameter ≤ 20/8 inch (63.5mm) shall meet 40lm/W. • Luminous efficacy (lm/W) for lamp diameter > 20/8 inch (63.5mm) shall meet 45lm/W.	✓ Review of laboratory test report(s) [Refer to Note]; AND ✓ Review of supporting information.
4.4 The power factor of lamps should meet for the following rated light wattage (Lw) as described in Table 1: 4.4.1 Lamps with integrated driver: • Lw ≤ 5W, the minimum allowable power factor should be 0.5 • 5W < Lw ≤ 25W, the minimum allowable power factor should be 0.7 • Lw > 25W, the minimum allowable power factor should be 0.9 4.4.2 Lamps with non-integrated driver: The minimum allowable power factor should be 0.9	✓ Review of laboratory test report(s) AND ✓ Review of supporting information.

Product Environmental Criteria	Verification Method(s)*
4.5 Safety requirement: Lamps shall comply with the Electrical Products (Safety) Regulation, Chapter 406G of the Laws of Hong Kong, and the safety standards specified under the Regulation. 4.6 Control of interference requirements Lamps shall comply with the requirements specified in the Telecommunications (Control of Interference) Regulations (Chapter 106B) of Law of Hong Kong, and international standards such as CISPR 15 or its equivalence.	✓ Review of laboratory test report(s) AND ✓ Review of supporting information.
5. **General Packaging requirements** General packaging requirement (Refer to criteria for packaging materials: GL-Packaging).	✓ Inspection of product samples; AND ✓ Review of supporting information; AND ✓ Interview with relevant personnel.

*Analytical testing should be accredited and performed by laboratories that meet the requirement laid out in the IEC/ISO 17025 or EN45001 standards or any equivalent systems e.g. HOKLAS, CNAS. Under special situation and with the approval from GC, test can be performed by in-house method by the accredited laboratory or manufacturer.

Note: Test Methods and Required Documents

Test	Suggested Method	Required Documents
Lumen Maintenance (L_{70})	IESNA LM-80-2008	Minimum 6,000 hour lumen maintenance data for the LED package(s) / array(s) / module(s) used in the integral LED lamp. Lumen maintenance data must meet at least the following conditions: • Collected at LED case or solder joint temperature (Ts) equal to or greater than the verified TMP temperature of the integral LED lamp; and • Measured at a forward drive current equal to or greater than the drive current applied to the LEDs in the integral LED lamp.
Color Rendering Index	ANSI C78.377-2008 IESNA LM-79-2008 CIE 13.3-1995 IESNA LM-58-94	Laboratory test results must be produced using the specific module(s)/array(s) and power supply combination that will be used in production.
Luminous Efficacy	IESNA LM-79-2008 ANSI C82.2-2002	Laboratory test results must be produced using the specific module(s)/array(s) and power supply combination that will be used in production.

Table 1: Luminous Efficacy and Power Factor Summary

<table>
<tr><td>Item</td><td>Details</td><td colspan="3">LED Lamp Requirement</td></tr>
<tr><td colspan="2"></td><td>Non-Directional Lamp Integrated Driver</td><td>Directional Lamp Integrated Driver</td><td>Directional Lamp Non-Integrated Driver</td></tr>
<tr><td>Power Factor</td><td>rated wattage < 5W</td><td colspan="2">> 0.5</td><td rowspan="3">> 0.9</td></tr>
<tr><td></td><td>rated wattage 5W to 25W</td><td colspan="2">> 0.7</td></tr>
<tr><td></td><td>rated wattage > 25W</td><td colspan="2">> 0.9</td></tr>
<tr><td>Luminous Efficacy</td><td></td><td>> 50 lm/W, for wattage < 10W</td><td colspan="2">> 40 lm/W, for lamp diameter < 63.5mm</td></tr>
<tr><td></td><td></td><td>> 55 lm/W, for wattage > 10W</td><td colspan="2">> 45 lm/W, for lamp diameter > 63.5mm</td></tr>
<tr><td>Luminous Intensity Distribution</td><td></td><td>nil</td><td colspan="2">80% light output within a cone of 120 degree</td></tr>
</table>

Table 2: CCT Requirements

Correlated Color Temperature	LED lamp requirement
rated CCT: 2700K	target CCT & tolerance: 2725 +- 145K, target Duv & tolerance: 0.000 +- 0.006
rated CCT: 3000K	target CCT & tolerance: 3045 +- 175K, target Duv & tolerance: 0.000 +- 0.006
rated CCT: 3500K	target CCT & tolerance: 3465 +- 245K, target Duv & tolerance: 0.000 +- 0.006
rated CCT: 4000K	target CCT & tolerance: 3985 +- 275K, target Duv & tolerance: 0.001 +- 0.006
rated CCT: 4500K	target CCT & tolerance: 4503 +- 243K, target Duv & tolerance: 0.001 +- 0.006
rated CCT: 5000K	target CCT & tolerance: 5028 +- 283K, target Duv & tolerance: 0.002 +- 0.006
rated CCT: 5700K	target CCT & tolerance: 5665 +- 355K, target Duv & tolerance: 0.002 +- 0.006
rated CCT: 6500K	target CCT & tolerance: 6530 +- 510K, target Duv & tolerance: 0.003 +- 0.006
flexible CCT (2700-6500K)	target CCT & tolerance: T +- ΔT, (i) target Duv & tolerance: Duv +- 0.006 (ii)

(i) T is chosen to be at 100 K steps (2800, 2900, ..., 6400 K) excluding those eight nominal CCTs listed in Table.

ΔT is given by $\Delta T = 0.0000108 \times T^2 + 0.0262 \times T + 8$.

(ii) Duv is given by $Duv = 57700 \times (1/T)^2 - 44.6 \times (1/T) + 0.0085$.